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NO 15

August 1979

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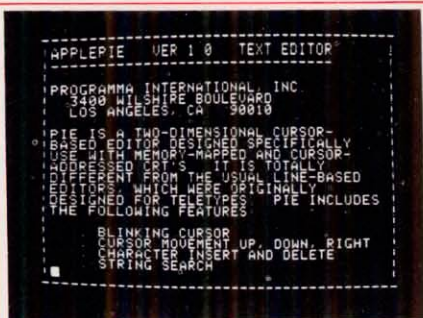


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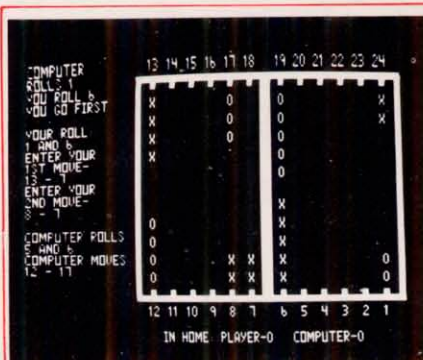
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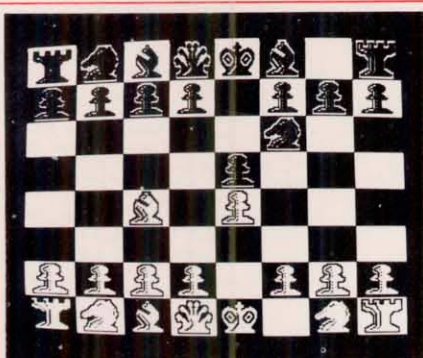
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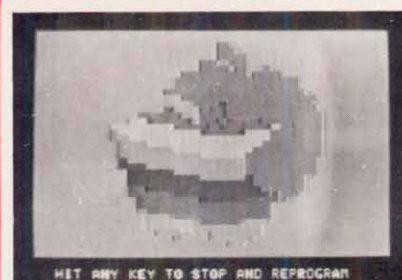
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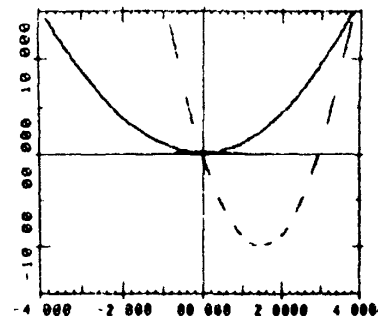
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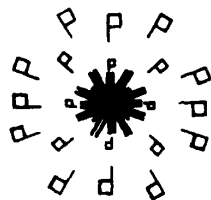
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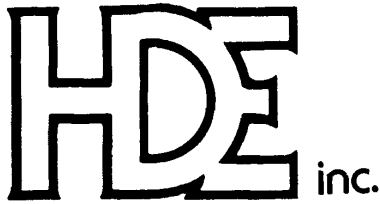
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REPRINTED BY PERMISSION FROM THE 6502 USER NOTES - ISSUE NO. 14

PRODUCT REVIEW of the HDE DISC SYSTEM by the editor.

A number of you have asked for details about the HDE full size disc system.

The system is based around the SYKES 8" drive with the 6502 based intelligent controller.

This drive is soft sector, IBM compatible, and single density which lets you store about a quarter megabyte of data on a disc.

The system software, called FODS (File Oriented Disc System), manages sequential files on the disc much the same way files are written on magnetic tape - one after another. When a file is deleted, from a sequentially managed file system, the space that the file occupied is not immediately reallocated, as in some disc operating systems. As it turns out, this can be an advantage as well as a disadvantage since deleted files on the FODS system can be recovered after the file has been deleted. (This has saved my sanity more than once!) Of course when you want to recover some of the disc space taken up by a number of these deleted files, you can simply re-pack or compress the disc and all the active files will be shifted down until there are no deleted files hanging around using up space.

FODS has this ability to repack a disc.

When saving and loading in FODS you work with named files, not track and sector data or I.D. bytes. This makes life a lot easier. I've seen some disc systems where you have to specify track and sector info and/or I.D. bytes. What a pain that can be!

If you just want to save a source file temporarily, you can do that on what's known as "scratch-pads". There are two of these on a disc, "scratch-pad A" and "scratch-pad B", each of these temporary disc files can hold up to 16K or if "B" is not used, "A" can hold one file up to 32K in length. The only files that can be temporarily saved on scratch pad are files that have been built using the system text editor.

Being a dyed in the wool assembly language programmer, I really appreciate the FODS text editor! This line oriented editor is upwards compatible with the MOS/ARESCO editor but includes about everything you could ask for in a line editor. There is a full and semi-automatic line numbering feature, lines can be edited while they are being entered or recalled and edited later, strings can be located and substituted, the line numbers can be resequenced, the file size can be found, the hex address of a line can be known and comments can be appended to an assembly file after it has been found correct. Oops! I

forgot to say lines can also be moved around and deleted. This isn't the complete list of FODS editor commands, just the ones that immediately come to mind.

Another very powerful feature of the system is the ability to actually execute a file containing a string of commands. For example, the newsletter mailing list is now being stored on disc. When I want to make labels, I would normally have to load each letter file and run the labels printing program. But with FODS, I can build up a "JOB" file of commands and execute it.

The job file in turn calls each lettered label file in and runs the label printer automatically. The way computers are supposed to operate right?

Here's a listing of the job file I use to print mailing labels:

```
:LIS PRTLBL
0005 LOD A:RUN %LABEL:LOD B:JMP.E000:
LOD C:JMP.E000:
0010 LOD D:JMP.E000:LOD E:JMP.E000:
LOD F:JMP.E000:
0015 LOD G:JMP.E000:LOD H:JMP.E000:
LOD I:JMP.E000:
0020 LOD J:JMP.E000:LOD K:JMP.E000:
LOD L:JMP.E000:
0025 LOD M:JMP.E000:LOD MC:JMP.E000:
LOD N:JMP.E000:
0030 LOD O:JMP.E000:LOD P:JMP.E000:
LOD R:JMP.E000:
0035 LOD S:JMP.E000:LOD T:JMP.E000:
LOD V:JMP.E000:
0035 LOD S:JMP.E000:LOD T:JMP.E000:
LOD V:JMP.E000:
0040 LOD W:JMP.E000:LOD XYZ:JMP.E000:
0045 LOD EXCH:JMP.E000:LOD COMP:
JMP.E000:
```

Remember the MOS/ARESCO assembler I reviewed several issues ago? Well HDE went and fixed up all the problem areas that I mentioned in the review and then took it several steps further. The HDE assembler is an honest to goodness two-pass assembler which can assemble anywhere in memory using multiple source files from the disc. The assembler is an optional part of the system.

If you're the kind of person (as I am) who enjoys having the ability to customize, modify, and expand everything you own - you'll enjoy the system expansion abilities FODS has to offer. Adding a new command is as simple as writing the program, giving it a unique three letter name and saving it to disc. Whenever you type those three letters the system will first go through its own command table, see that it's not there and then go out

and read the disc directory to see if it can find it. If it's on the disc it will read it in and execute it. Simple right? I've added several commands to my system and REALLY appreciate having this ability. Some of the things I've added include a disassembler, an expanded version of XIM (the extended machine language monitor from Pyramid Data), Hypertape, and a number of system utilities which make life easier. By the way, to get back to the system, all you need to do is execute a BRK instruction.

HDE also provides a piece of software that lets you interface Microsoft 9 digit BASIC to their disc system. The software allows you to load the BASIC interpreter itself from disc as well as saving and loading BASIC Programs to and from the disc. This particular version of the software doesn't allow for saving BASIC data but HDE mentioned that this ability may be possible with a future version.

The first thing I do with a new piece of software after I get used to using it is try to blow it up. I did manage to find a weak spot or two in the very first version of FODS (a pre-release version) but the later, release version has been very tight.

The standard software that is included with the system consists of the disc driver software, the system text editor and the BASIC software interface. Several command extensions may also be included. All the necessary stuff like a power supply, the KIM-4 interface card, and all cables and connectors are included. It took me about 45 minutes to get things up and running the first time I put the system together.

Admittedly, a dual full size disc system from HDE is probably beyond the means of most hobbyists but if you or your company is looking for a dynamite 6502 development system, I would recommend this one. I've used the Rockwell System 65 while I was at MOS and feel that dollar for dollar, feature for feature, the HDE system comes out on top. The only place the HDE system falls short when stacked up next to the System 65 is in the area of packaging. At this point, there is no cabinet for the disc drives available from HDE.

So far, I've got nothing but good things to say about HDE and their products. Everything I've received from them has been industrial quality. That includes their documentation and product support. I'm very impressed with what I've seen from this company so far and quite enthusiastic over what my KIM has become since acquiring the disc system and its associated software.

ERIC

THANK YOU MR. REHNKE!

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APPLE II Serial Output Made Simple

Is the APPLE II simple serial output as easy to implement as everyone claims? Almost! But a few helpful hints gleaned from this designer's experience may get that output port into service quite a bit sooner.

Donald W. Bixby
5 King Philip Trail
Norfolk, MA 02056

When Apple sent the new **Apple II Reference Manual** (January 1978), I jumped at the article on page 114, "A Simple Serial Output". A printer output was badly needed in my system. I built the RS-232 output as described, typed in the program, borrowed a terminal from my place of business and started things up.

An oscilloscope on the RS-232 output disclosed that the signal was reaching +12v, but going only slightly negative.

The printer did work correctly, but I was concerned. Examination of the RS-232C specification disclosed that the printer on the data receiving end must have 3K input impedance. The printer manual stated only that the impedance was "at least" 3K. Since the Apple circuit was uses a 2.2K resistor to -12v, the source impedance, when negative, is much too

high. I replaced the Apple circuit with a single inverter (74LS04) driving an RS-232 driver integrated circuit manufactured by Motorola (MC1488L). This worked fine.

The only other hardware problem related to page 115 in Apple's manual. The statement, "The signal output connects to pin 3 of the DB-25 connector", is confusing. It is correct if you are connecting it to a DB-25 connector, which is to be used with a standard RS-232 cable with the other end of the cable connected to the printer. The cable connects pin 3 at the source end to pin 2 of the receiving end. If you are connecting directly to the printer, use pin 2, not pin 3.

Now the fun began. The printer I used can be operated at 110 baud, 150 baud, or 300 baud, front panel switch selectable. Apple's program was all written for

110 baud. Naturally I wanted the fastest speed. For any speed higher than 110 baud, 1 stop bit is used instead of 2. This is easily changed by writing location \$03C6 with 0A.

The routine TTOUT4 causes a 9.091 msec. delay (1/110 baud = 9.091 ms). For 300 baud, I needed 3.333 ms. This was accomplished by changing location 03D4 from D7 to 4E.

The printer will now work at 300 baud with three problems remaining. The first was simple, the second took two weeks to figure out and the third was minor.

When a carriage return is transmitted, the program sends the carriage return to the printer, then automatically sends a line feed to the printer, then waits 200 ms for the carriage return to be completed. My printer requires the 200 ms. delay, but others will be different. For example, the DECwriter requires no delay. After speeding up to 300 baud, I was not getting enough delay. I changed location 03AC from 58 to FF, an arbitrary choice, and this problem was fixed.

The program is supposed to detect when the next column to be printed, COLCNT, exceeds the number of columns available, WNDWDTH, and then transmit an automatic CR, LF, and delay. It won't, it can't and it didn't. The intention of the Apple program routine, FINISH is to make CH equal to 39 and then depend on the system monitor routines to generate the CR, LF and delay. This doesn't work.

I have modified their program to make this happen within the TTY routines. If COLCNT equals or exceeds WNDWDTH, the program branches to RETURN. This causes a carriage return and then branches to AUTOLF, the same section of program used for automatic line feed and delay by Apple.

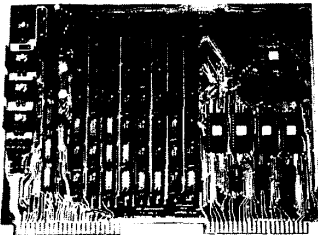
The last problem encountered involved getting out of the printer routines and back to the video display. New code was written to solve this problem.

The new program, shown here, has been relocated to addresses 30A through 3A2. With all the components, I believe it is self explanatory. I also wrote an AppleSoft BASIC program to modify and test the machine language program.

```
10 REM PRINTER TEST AND MODIFY PROGRAM IN APPLESOFT BASIC
15 CALL -936:PRINT:PRINT
20 INPUT "110 OR 300 BAUD";A
30 IF A=110 THEN 70
40 POKE 868,10
50 POKE 882,78
52 PRINT:INPUT "200 OR 0 MS CARRIAGE RETURN DELAY";M
54 IF M=200 THEN M=255
60 POKE 843,M
70 PRINT:INPUT "HOW MANY CHARACTERS TO A LINE";N
80 POKE 787,N
90 PRINT:PRINT
100 PRINT N;"CHARACTERS TO A LINE"
110 IF A=300 THEN 220
120 POKE 868,11
130 POKE 882,215
132 PRINT:INPUT "200 OR 0 MS CARRIAGE RETURN DELAY";M
134 IF M=200 THEN M=88
140 POKE 843,M
220 PRINT:PRINT:INPUT "CHARACTERS TO BE PRINTED";A$
230 PRINT:PRINT:PRINT A$
240 PRINT:PRINT:PRINT "OUTPUT IS NOW GOING TO THE PRINTER AT A";A;"BAUD
RATE"
250 CALL 778
260 FOR J=1 TO 10
270 PRINT A$
280 NEXT J
300 CALL 914
310 PRINT:PRINT
320 INPUT "CONTINUE (Y OR N)";B$
330 IF B$="Y" THEN 230
340 END
```

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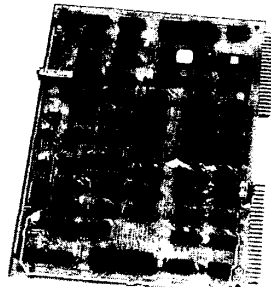
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RS-232 DRIVER ROUTINES
REVISED 3-30-79 BY DONALD W. BIXBY
REVISED 6-6-79 BY MICRO STAFF

TO CALL TTINIT FROM SYSTEM MONITOR: * <30AG
TO CALL VIDINIT FROM SYSTEM MONITOR: * <392G

TO CALL TTINIT FROM FP BASIC: CALL 778
TO CALL VIDINIT FROM FP BASIC: CALL 914

TO READ FROM TAPE: *30A.3A2R
TO WRITE TO TAPE: *30A.3A2W

TO MAKE CHANGES:

TO CHANGE WINDOW WIDTH:

* <313:48 (FOR 72 COLUMNS)
* <313:50 (FOR 80 COLUMNS)
]POKE 787,72 (FOR 72 COLUMNS)
]POKE 787,80 (FOR 80 COLUMNS)

TO CHANGE CARRIAGE RETURN DELAY:

* <34B:58
]POKE 843,88

TO CHANGE NUMBER OF STOP BITS:

*364:0A (FOR 1 STOP BIT)
*364:0B (FOR 2 STOP BITS)
]POKE 868,10 (FOR 1 STOP BIT)
]POKE 868,11 (FOR 2 STOP BITS)

TO CHANGE THE BAUD RATE:

*372:7D (FOR 110 BAUD)
*372:4E (FOR 300 BAUD)
]POKE 882,215 (FOR 110 BAUD)
]POKE 882,78 (FOR 300 BAUD)

03A3	WINDWT *	\$0021	FOR THE APPLE II
03A3	CH *	\$0024	CURSOR HORIZONTAL POSITION
03A3	CSWL *	\$0036	CHARACTER OUT SWITCH LO ORDER
03A3	CSWH *	\$0037	CHARACTER OUT SWITCH HI ORDER
03A3	YSAVE *	\$0308	
03A3	COLCNT *	\$0307	COLUMN COUNT LOCATION
03A3	MARK *	\$C058	
03A3	SPACE *	\$C059	
03A3	WAIT *	\$FCA8	
03A3	RTS1 *	\$0309	
030A	ORG	\$030A	
030A A9 21	TTINIT LDAIM	\$0021	EQUALS TTOUT-768 POINTER TO
030C 85 36	STA CSWL		RS-232 ROUTINES, LOW BYTE
030E A9 03	LDAIM	\$0003	EQUALS TTOUT/256
0310 85 37	STA CSWH		HIGH BYTE
0312 A9 48	LDAIM	\$0048	
0314 85 21	STA WINDWT		72 COLUMN WINDOW WIDTH
0316 A5 24	LDA CH		
0318 8D 07 03	STA COLCNT		PRESENT COLUMN
031B A9 60	LDAIM	\$0060	
031D 8D 09 03	STA RTS1		STORE CONSTANT
0320 60	RTS		RETURN FROM TTINIT
0321 48	TTOUT PHA		SAVE CHARACTER ON THE STACK
0322 48	PHA		
0323 AD 07 03	TTOUT2 LDA	COLCNT	
0326 C5 24	CMP CH		CHECK FOR A TAB
0328 68	PLA		RESTORE CHARACTER
0329 B0 03	BCS TESTCT		IF CARRY SET, NO TAB
032B 48	PHA		

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by Commodore
The Original 6502 System

20 mA Current Loop TTY Interface

Audio Cassette Interface

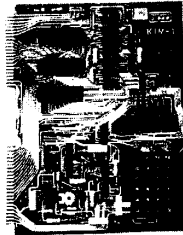
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2 Interval Timers

1K - RAM

2K KIM Monitor ROM

Hex Keypad/LED Display



KIM-1: \$18000

ENCLOSURE PLUS™

The Ultimate Enclosure
for the KIM-1

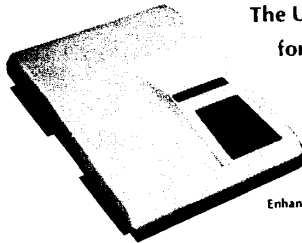
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Enhances the LED Display with a Red Lens

Room for the KIM-1 and One
Additional Board such as
MEMORY PLUS or VIDEO PLUS.



ENCLOSURE PLUS
for KIM: \$3000

AIM 65

by Rockwell International
The Complete 6502 System

20 Column Thermal Printer

High Speed Audio Cassette

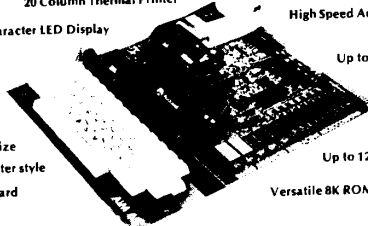
20 Character LED Display

Up to 4K RAM on board

Full size
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Keyboard

Up to 12K additional ROM

Versatile 8K ROM Monitor



AIM 65: \$37500 1K RAM - \$42000 4K RAM

AIM PLUS™

ENCLOSURE
WITH BUILT IN
POWER SUPPLY

SPECIFICATIONS:

INPUT: 110/220 VAC 50/60 Hz

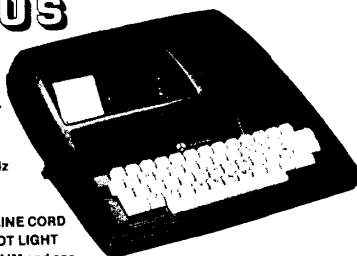
OUTPUT: +5V @ 5A

+24V @ 1A

GROUNDING THREE-WIRE LINE CORD

ON/OFF SWITCH WITH PILOT LIGHT

Enclosure has room for the AIM and one
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```

0540: 033D 85 3E
0550: 033F A5 6E
0560: 0341 85 3F

0570: 0343 A0 00
0580: 0345 20 2C FE
0590: 0348 38
0600: 0349 A5 6B
0610: 034B E5 69
0620: 034D 85 1C
0630: 034F A5 6C
0640: 0351 E5 6A
0650: 0353 85 1D
0660: 0355 60
0670:
0680: 0356 A5 1A
0690: 0358 85 3C
0700: 035A A5 1B
0710: 035C 85 3D
0720: 035E A5 18
0730: 0360 85 6F
0740: 0362 85 3E
0750: 0364 A5 19
0760: 0366 85 70
0770: 0368 85 3F
0780: 036A A5 69
0790: 036C 85 42
0800: 036E A5 6A
0810: 0370 85 43
0820: 0372 A0 00
0830: 0374 20 2C FE
0840: 0377 18
0850: 0378 A5 69
0860: 037A 65 1C
0870: 037C 85 6B
0880: 037E A5 6A
0890: 0380 65 1D
0900: 0382 85 6C
0910: 0384 38
0920: 0385 A5 6F
0930: 0387 E5 1A
0940: 0389 85 6D
0950: 038B A5 70
0960: 038D E5 1B
0970: 038F 85 6E
0980: 0391 18
0990: 0392 A5 6D
1000: 0394 65 69
1010: 0396 85 6D
1020: 0398 A5 6E
1030: 039A 65 6A
1040: 039C 85 6E
1050: 039E A5 6D
1060: 03A0 D0 02
1070: 03A2 C6 6E
1080: 03A4 C6 6D
1090: 03A6 60

0030:
0040:
0050:
0060:
0070:
0080:
0090:
0100: 0318
0110: 0318
0120: 0302
0130: 0302 4C 0F 03
0140: 0305 00
0150: 0306 A5 CC
0160: 0308 85 1A
0170: 030A A5 CD
0180: 030C 85 1B
0190: 030E 60
0200:
0210: 030F A5 1A
0220: 0311 85 CC
0230: 0313 A5 1B
0240: 0315 85 CD
0250: 0317 60

```

```

STA A2L
LDA $006E
STA A2H
LDYIM $00
JSR $FE2C USE MONITOR MOVE ROUTINE
SEC COMPUTE DISPLACEMENT
LDA $006B TO ARRAYS
SBC $0069
STA EL
LDA $006C
SBC $006A
STA EH
RTS BACK TO BASIC

*
RECALL LDA CL ***ENTRY 770 - RECALL VARIABLES
STA A1L SET UP MOVE
LDA CH
STA A1H
LDA DL
STA $006F START OF STRINGS
STA A2L
LDA DH
STA $0070
STA A2H
LDA $0069 START OF NUMERICS
STA A4L
LDA $006A
STA A4H
LDYIM $00
JSR $FE2C USE MONITOR MOVE ROUTINE
CLC COMPUTE START
LDA $0069 OF ARRAYS
ADC EL
STA $006B
LDA $006A
ADC EH
STA $006C
SEC COMPUTE END OF NUMERICS
LDA $006F
SBC CL
STA $006D
LDA $0070
SBC CH
STA $006E TEMP STORAGE
CLC
LDA $006D
ADC $0069
STA $006D TEMP VALUE
LDA $006E
ADC $006A
STA $006E TEMP VALUE
LDA $006D SUBTRACT ONE
BNE A2
DEC $006E END OF NUMERICS
A2 DEC $006D
RTS BACK TO BASIC

* ROUTINE TO SAVE AND RECALL
* COMMON VARIABLES FOR INTEGER BASIC
* PROGRAMS ON THE APPLE II
*
* WRITTEN 03/16/79 BY ROBERT F. ZANT
* MODIFIED 7/4/79 BY MICRO STAFF
*
CL * $001A
CH * $001B
ORG $0302
JMP RECALL ***ENTRY 770
BRK
LDA $00CC ***ENTRY 774 - SAVE VARIABLES
STA CL SAVE END OF
LDA $00CD VARIABLE TABLE
STA CH
RTS BACK TO BASIC

RECALL LDA CL ENTRY 770 - RECALL VARIABLES
STA $00CC RESET END OF
LDA CH VARIABLE TABLE
STA $00CD
RTS BACK TO BASIC

```

032C	A9	A0		LDAIM	\$00A0	PRINT A SPACE
032E	2C	09	03	TESTCT	BIT	RTS1 IS CHARACTER A CONTROL?
0331	F0	03		BEQ	PRNTIT	IF SO, BRANCH TO PRINT IT
0333	EE	07	03	INC	COLCNT	IF NOT, INCREMENT COLUMN COUNT
0336	20	5F	03	PRNTIT	JSR	DOCHAR PRINT THE CHARACTER
0339	68			PLA		RESTORE CHARACTER
033A	48			PHA		AND PUT BACK ON THE STACK
033B	90	E6		BCC	TTOUT2	DO MORE SPACES FOR TAB CHAR
033D	49	0D		EORIM	\$000D	CHECK FOR CARRIAGE RETURN
033F	0A			ASLA		ELIMINATE PARITY
0340	D0	0D		BNE	FINISH	DONE UNLESS HAVE CARRIAGE RETU
0342	8D	07	03	AUTOLF	STA	COLCNT CLEAR COLUMN COUNTER
0345	A9	8A		LDAIM	\$008A	
0347	20	5F	03	JSR	DOCHAR	PRINT A LINE FEED
034A	A9	58		LDAIM	\$0058	
034C	20	A8	FC	JSR	WAIT	200 MS DELAY FOR CR LF
034F	AD	07	03	FINISH	LDA	COLCNT
0352	F0	07		BEQ	SETCH	BRANCH IF COLUMN COUNTER = 0
0354	E5	21		SBC	WNDWDT	ELSE SUBTRACT WINDOW WIDTH
0356	B0	30		BCS	RETURN	RETURN IF IN THE MARGIN
0358	AD	07	03	LDA	COLCNT	
035B	85	24		SETCH	STA	CH STORE NEW VALUE IN CH
035D	68			PLA		RESTORE THE STACK
035E	60			RTS		RETURN FROM TTOUT
035F	8C	08	03	DOCHAR	STY	YSAVE ROUTINE TO PRINT A
0362	08			PHP		CHARACTER
0363	A0	0B		LDYIM	\$000B	FOR 11 BITS
0365	18			CLC		(2 STOP BITS)
0366	48			TTOUT3	PHA	
0367	B0	05		BCS	MARKOU	
0369	AD	59	C0	LDA	SPACE	SEND A SPACE
036C	90	03		BCC	TTOUT4	
036E	AD	58	C0	MARKOU	LDA	MARK SEND A MARK
0371	A9	D7		TTOUT4	LDAIM	\$00D7 DELAY 9.091 MS FOR 110 BAUD
0373	48			DLY1	PHA	
0374	A9	20		LDAIM	\$0020	
0376	4A			DLY2	LSRA	
0377	90	FD		BCC	DLY2	
0379	68			PLA		
037A	E9	01		SBCIM	\$0001	
037C	D0	F5		BNE	DLY1	
037E	68			PLA		
037F	6A			RORA		NEXT BIT
0380	88			DEY		DECREMENT Y
0381	D0	E3		BNE	TTOUT3	IF Y IS NONZERO,
0383	AC	08	03	LDY	YSAVE	DO THE NEXT BIT
0386	28			PLP		
0387	60			RTS		RETURN FROM DOCHAR
0388	A9	8D		RETURN	LDAIM	\$008D
038A	20	5F	03	JSR	DOCHAR	PRINT CARRIAGE RETURN
038D	A9	00		LDAIM	\$0000	
038F	4C	42	03	JMP	AUTOLF	
0392	A9	F0		VIDINI	LDAIM	\$00F0 POINT TO VIDEO DISPLAY ROUTINE
0394	85	36		STA	CSWL	LOW ORDER BYTE
0396	A9	FD		LDAIM	\$00FD	
0398	85	37		STA	CSWH	HIGH ORDER BYTE
039A	A9	28		LDAIM	\$0028	
039C	85	21		STA	WNDWDT	40 COLUMN WINDOW WIDTH
039E	A9	00		LDAIM	\$0000	
03A0	85	24		STA	CH	SET HORIZONTAL CURSOR
03A2	60			RTS		TO 0 AND RETURN FROM VIDINIT

SYMBOL TABLE 2000 209C

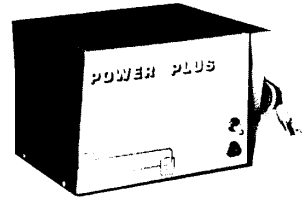
AUTOLF	0342	CH	0024	COLCNT	0307	CSWH	0037
CSWL	0036	DLYQ	0373	DLYR	0376	DOCHAR	035F
FINISH	034F	MARK	C058	MARKOU	036E	PRNTIT	0336
RETURN	0388	RTSQ	0309	SETCH	035B	SPACE	C059
TESTCT	032E	TTINIT	030A	TTOUT	0321	TTOUTR	0323
TTOUTS	0366	TTOUTT	0371	VIDINI	0392	WAIT	FCA8
WNDWDT	0021	YSAVE	0308				

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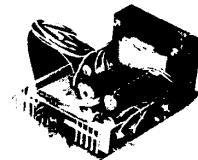


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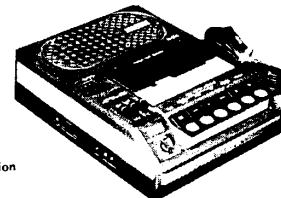
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Extending the SYM-1 Monitor

A program relocater, a program listing utility and a selective, extended trace routine illustrate how true monitor extensions can implement additional functions and commands.

Nicholas Vrtis
5863 Pinetree S.E.
Kentwood, MI 49508

When Synertek wrote the monitor for the SYM-1, they left it open-ended by vectoring many of the major functions through a system RAM vector table. By changing the addresses in the vector table, it is relatively easy to implement additional functions and commands.

The three routines described in this article are almost permanently resident in my system. They have been coded as true monitor extensions in that they use only addresses already allocated to the monitor and could easily be put into ROM.

The programs are not complex or large, but that is also one of their good points. I have them sitting up in high memory where they are out of the way but available when needed.

The first program is a modified version of one that appears in *The First Book of KIM*. It is a program relocater that adjusts all the branches, jumps, and absolute address locations in a program so that you can relocate it. It is really the next best thing to a relocating loader.

The second routine is a little program lister that prints your program, putting one instruction on each line. This is easier to read and check than the standard Verify or Paper tape formats.

Finally, there is an extended trace routine that displays the values of all the registers, and additionally allows you to specify that only a portion of your program is to be traced. Did you ever wonder what was happening to the registers when one of your subroutines is executed only five times in a two thousand repetition loop? This utility lets you determine just that. There is a price that is paid, but I will get to that later.

If you have looked at the program code yet, you may have wondered at the unusual address. After all, who ever puts an extension in low memory? When I decided to write this article, I intended to use address \$C00, where I have it on

my system, but then I decided to change it to low memory.

Almost everyone has scratch memory there to work on a program. After you enter it, check the memory dump, and run a few tests; you can use the program to relocate itself!

Actually, what you have to do is block move the program to the desired address and use the new U0 command to perform the relocation on the new copy. Tell it the correct FROM and TO address, but make the program starting address the new location. There are three locations that must be changed manually, and you are all set up.

Before I go into a discussion about the programs, I would like to mention the interfaces to the SYM monitor that are used, and a few that aren't but are sort of handy anyway. The programs themselves are not complicated, and I try to keep them pretty well commented.

The SYM manual contains a small example showing how to add a command to the monitor, but isn't really clear about how it works. For one thing, the monitor uses the unrecognized command vector for more than just the U0 through U7 user commands. It does a jump via this vector whenever it encounters a command it cannot process, or a character that is non-hex.

MICRO-WARE ASSEMBLER 65XX-1.0 PAGE 01

```
0010:
0020:
0030:
0040:
0050:
0060:
0070:
0080:
0090:
0100:
0110:
0120:
0130:
0140:
0150:
0160:
0170:
0180:
0190: 0200
0200: 0200 53
0210: 0201 44
0220:
0230:
0240:
0250: 0202 32
0260: 0203 32
0270: 0204 43
0280: 0205 2C
0290: 0206 41
0300: 0207 36
0310: 0208 36
0320: 0209 44

*****
* SYM-1 USER MONITOR FUNCTION EXTENSIONS *
*   MODIFIED 7/3/79 BY MICRO STAFF   *
* U0 - RELOCATE PROGRAM *
*   P1 = FROM ADDRESS *
*   P2 = TO ADDRESS *
*   P3 = START OF PROGRAM *
* U1 - MINI-PROGRAM LISTER *
*   P1 = PROGRAM STARTING ADDRESS *
*   P2 = PROGRAM ENDING ADDRESS *
* ---- USER TRACE ROUTINE Y-X-A-FLAGS-STACK *
*   A626 = INCLUSIVE TRACE STARTING ADDRESS *
*   A62C = EXCLUSIVE TRACE ENDING ADDRESS *
*
* SYM COMMAND 'E 200' WILL SET UP VARIOUS ADDRESSES *
* AND VALUES FOR THESE EXTENSIONS *
*****
          ORG    $0200
INITCO =    $53    STORE "SD" USER ROUTINE VECTOR
          =    $44

*****
* CHANGE THE FOLLOWING WHEN RELOCATING THE PROGRAM *
*****
          =    $32    STORE "22C" AND CHANGE
          =    $32    IF ADDRESS CHANGES
          =    $43
          =    $2C    STORE ",A66D"
          =    $41
          =    $36
          =    $36
          =    $44
```

```

0330: 020A 0D      =      $0D
0340: 020B 4D      =      $4D   STORE "MA658" AND CHANGE
0350: 020C 41      =      $41   MAX RECORD
0360: 020D 36      =      $36   TO BE
0370: 020E 35      =      $35   TWENTY-FOUR
0380: 020F 38      =      $38   BYTES LONG
0390: 0210 0D      =      $0D
0400: 0211 31      =      $31   STORE "18"
0410: 0212 38      =      $38
0420: 0213 0D      =      $0D
0430: 0214 53      =      $53   SET TRACE VECTOR
0440: 0215 44      =      $44
0450: 0216 38      =      $38   STORING STRING "SD80C0,A67A"
0460: 0217 30      =      $30
0470: 0218 43      =      $43
0480: 0219 30      =      $30
0490: 021A 2C      =      $2C
0500: 021B 41      =      $41
0510: 021C 36      =      $36
0520: 021D 37      =      $37
0530: 021E 41      =      $41
0540: 021F 0D      =      $0D
0550: 0220 53      =      $53   STORE "SD"
0560: 0221 44      =      $44
0570:
0580: *****
0590: * CHANGE THE FOLLOWING WHEN RELOCATING THE PROGRAM *
*****
0600: 0222 33      =      $33   STORE "341" AND CHANGE IF ADDRESS CHANGES
0610: 0223 34      =      $34
0620: 0224 31      =      $31
0630: 0225 2C      =      $2C   STORE ",A674"
0640: 0226 41      =      $41
0650: 0227 36      =      $36
0660: 0228 37      =      $37
0670: 0229 34      =      $34
0680: 022A 0D      =      $0D
0690: 022B 00      =      $00   ZERO IS END OF EXEC REQUEST
0700: *****
0710: * PAGE ZERO ADDRESS LOCATIONS *
0720: *****
0730:
0740: 022C CURAD *      $00FE  SYM-1 "OLD ADDRESS LOW ORDER
0750: 022C CURADH *     $00FF  AND HIGH-ORDER
0760: 022C ADJUST *     $00FC  SYM-1 PAGE ZERO SCRATCH AREA LOW-ORDER
0770: 022C ADJUSH *     $00FD  AND HIGH ORDER
0780: *****
0790: * BY JIM BUTTERFIELD (SEE "THE FIRST BOOK OF KIM") *
0800: * MODIFIED BY N. VRTIS TO RUN AS MONITOR *
0810: * EXTENSIONS ON THE SYM-1 *
0820: *
0830: * THIS PROGRAM ADJUSTS ABSOLUTE AND RELATIVE *
0840: * ADDRESSES OF A PROGRAM SO IT CAN BE RELOCATED *
0850: * OR EXPANDED *
0860: * >>>> NOTES: *
0870: * 1- PAGE ZERO REFERENCES ABOVE $8000 WILL NOT *
0880: * BE CHANGED UNLESS SPECIFIED AS ABSOLUTE *
0890: * THREE-BYTE INSTRUCTIONS *
0900: * 2- ANY REFERENCES ABOVE $8000 WILL NOT BE *
0910: * CHANGED *
0920: * 3- PROGRAM STOPS WHEN IT FINDS AN ILLEGAL *
0930: * OPERATION CODE (CAN USE $FF) *
0940: * 4- DON'T RELOCATE DATA *
0950: *
0960: * INPUT PARMS: *
0970: * PARM1 - RELOCATE FROM ADDRESS *
0980: * (FIRST OPCODE THAT WILL MOVE) *
0990: * PARM2 - RELOCATE TO ADDRESS (WHERE PARM1 *
1000: * WILL BE MOVED TO) *
1010: * PARM3 - PROGRAM START ADDRESS (FIRST *
1020: * INSTRUCTION IN PROGRAM *
1030: *****
1040: 022C CD 57 A6      CMP LSTCOM SEE IF COMMAND TERMINATED PROPERLY
1050: 022F F0 02      BEQ U0 YES -- SEE WHICH COMMAND
1060: 0231 38 COMERR SEC ELSE SET CARRY AS ERROR FLAG
1070: 0232 60 RTS AND RETURN TO MONITOR FOR ER XX
1080:
1090: 0233 C9 14 U0 CMPIM $14 MAKE SURE IT IS "U0"
1100: 0235 F0 03 BEQ UOCOMM BRANCH IF IT IS

```

This means that it gets used for a lot of junk in addition to the defined user commands. It also means that you can use characters other than Un as command extensions, if you want, as long as they are not used for valid SYM commands with the same number of parameters.

The monitor saves the command value in a location called LSTCOM. When a carriage return is entered, the monitor reloads the command into the A register and loads the number of parameters into X.

So, the first thing our monitor extension should do is check the character in A against the value in LSTCOM. If they are the same, the program was called after normal command termination. If they are different, the command was not terminated properly and we want to make sure the carry is set and return with an RTS instruction.

This will cause the monitor to print the standard "ER xx" message and return to command mode.

Once we know that the command was terminated properly, we have to determine which command it was. As I mentioned earlier, the monitor does not verify the command character as it is entered, so we could be here for anything, including a "valid" command with the wrong number of parameters.

Finally, if we are on the right command, and if it was terminated properly, the last check is to make sure that exactly the correct number of parameters has been entered. If not, there will be missing information, or information will be in the wrong place. For any errors, all the extension has to do is guarantee that the carry is set and return to the monitor with an RTS instruction.

As an aside, the command processor does not initialize the stack register, and so, if you are debugging an extension and stop it before the RTS to the monitor, you can quickly use up a lot of the stack area. This only hurts if you have a routine or two located there, as I usually do.

The manual claims that locations \$F8 through \$FF are reserved for monitor use. Did you ever wonder what they are used for? Unfortunately, these locations were not assigned a variable name in the monitor assembly, so there are no cross references to them in the listing. I have tracked down most of the applications, but I don't guarantee that I didn't miss one.

The most used locations are probably \$FE and \$FF. These are the locations

that the monitor uses for almost all of it's indirect addressing. If you look at the command descriptions, this is where the "OLD" address is kept.

These programs use it in the same manner that the monitor does. It's impossible to display these locations via the monitor commands directly, but doing a Verify or Memory will show you what they are pointing to. Also, if you plan to use them, none of the monitor routines will change them, but almost any command will.

Another important pair of locations is \$FA and \$FB. These contain the address of the next byte to be obtained as input when processing in the execute mode. If your program modifies these locations, it can't be invoked from the execute mode.

As another aside about the execute mode, all input comes from RAM, so if you do a JSR INCHR and expect to get keyboard input while in execute mode it won't work. The execute command is the only one that modifies these addresses. The other locations are pretty much scratch locations; you can probably use them without affecting command operation, but I would not count on them being the same after any call to monitor service routines.

The cassette routines use \$FC and \$FD, as does the block move command. Terminal input uses \$F8 as a character buildup area, and terminal output uses \$F9 to hold the character as it is being output. There may be a few other uses, but I would stay away from these unless you are really desperate for page zero space, or you are writing monitor extensions.

The System RAM areas are much better documented in the monitor listing. They have also been assigned names, and therefore appear on the assembly cross reference list. These programs only deal with two main areas. This is \$A630 through \$A63F, and they are monitor scratch areas. The two bytes used here are not used by the monitor, according to the cross reference lists.

The locations \$A64A through \$A64F are the addresses where the monitor collects input parameters. Each is a two byte parameter area, and all three areas are initialized to zero at the start of command processing. The problems begin when you find that the labels P1, P2 and P3 are a little misleading. The monitor starts collecting parameters in the P3 area, and rotates the whole area 16 bits left for each new parameter. It works out all right for three parameters, but two parameters will end up in P3 and P2, while one ends up in P1.

```

1110: 0237 4C DE 02      JMP U1      GO TRY AS U1 COMMAND
1120: 023A E0 03      UOCOMM CPXIM $03  MAKE SURE HAVE THREE PARMS
1130: 023C D0 F3      BNE COMERR  BRANCH FOR ERROR IF NOT
1140:
1150:
1160:      * NOW COMPUTE THE ADJUSTMENT INCREMENT
1170: 023E 38      SEC      SET BORROW
1180: 023F AD 4C A6     LDA P2L  GET LOW-ORDER "TO"
1190: 0242 ED 4E A6     SBC P1L  CALC DIFFERENCE
1200: 0245 85 FC      STA ADJUST SAVE IN PAGE ZERO LOW-ORDER
1210: 0247 AD 4D A6     LDA P2H  SAME FOR HIGH-ORDER
1220: 024A ED 4F A6     SBC P1H
1230: 024D 85 FD      STA ADJUST IT GOES INTO PAGE ZERO ALSO
1240:
1250:      * NOW PUT PROGRAM POINTER TO PAGE ZERO
1260:
1270: 024F 20 A7 82      JSR P3SCR
1280:
1290:      *****
1290:      * GET AN OPCODE HERE
1290:      *****
1300:
1310:
1320: 0252 20 24 03     GETOP JSR DETLEN FIND OPCODE LENGTH AND TYPE
1330: 0255 30 07      BMI TRIPLE MINUS IS LENGTH 3 OR BAD TYPE
1340: 0257 F0 2A      BEQ BRANCH ZERO IS A BRANCH
1350:
1360:
1370:
1380:      *****
1380:      * HERE WE HAVE TO SKIP FORWARD TO NEXT OPCODE
1380:      *****
1390:
1400: 0259 20 1A 03     SKIP1 JSR ADVANC
1410: 025C F0 F4      BEQ GETOP AND THEN GO GET THE NEXT OPCODE
1420:
1430:
1440:
1450:      *****
1450:      * GOT A 3 BYTE OPCODE / ILLEGAL / OR END (SPECIAL)
1450:      *****
1460:
1470: 025E C8      TRIPLE INY      BUMP Y BY ONE
1480: 025F F0 0F      BEQ FIX3BY IF NOW ZERO IT IS A 3 BYTER
1490:
1500: 0261 20 15 83     QUITDC JSR CRLFSZ OUTPUT LAST ADDRESS
1510: 0264 20 42 83     JSR SPACE FOLLOWED BY A SPACE
1520: 0267 A0 00      LDYIM $00 AND THE OPCODE
1530: 0269 B1 FE      LDAIY CURAD
1540: 026B 20 FA 82     JSR OUTBYT
1550: 026E 18      CLC      CLEAR THE CARRY
1560: 026F 60      RTS      AND RETURN TO SYSTEM
1570:
1580: 0270 C8      FIX3BY INY      MAKE Y=1 NOW
1590: 0271 B1 FE      LDAIY CURAD LOW-ORDER PART OF ADDRESS
1600: 0273 AA      TAX      PUT INTO X
1610: 0274 C8      INY      NOW MAKE Y=2
1620: 0275 B1 FE      LDAIY CURAD HIGH-ORDER PART OF ADDRESS
1630: 0277 20 B6 02     JSR ADJUST GO CHANGE ADDRESS IF NECESSARY
1640: ID=02
0010:
0020: 027A 91 FE      STAIY CURAD PUT HIGH-ORDER BACK
0030: 027C 88      DEY      MAKE Y=1
0040: 027D 8A      TXA      LOW-ORDER TO A
0050: 027E 91 FE      STAIY CURAD PUT IT BACK ALSO
0060: 0280 4C 59 02     JMP SKIP1 GO SKIP FORWARD TO NEXT OPCODE
0070:
0080:
0090:      *****
0090:      * GOT A BRANCH - HAVE TO CHECK
0090:      * BOTH "TO " AND "FROM" ADDRESSES
0090:      *****
0100:
0110:
0120:
0130: 0283 C8      BRANCH INY      MAKE Y=1
0140: 0284 A6 FE      LDX CURAD GET CURRENT LOCATION LOW-ORDER
0150: 0286 A5 FF      LDA CURADH AND HIGH-ORDER
0160: 0288 20 B6 02     JSR ADJUST FIX IT IF NECESSARY
0170: 028B 8E 30 A6     STX SCRO SAVE LOW-ORDER FOR NOW
0180: 028E A2 FF      LDXIM $FF SET FLAG FOR BACK REFERENCE
0190: 0290 B1 FE      LDAIY CURAD GET RELATIVE BRANCH AMOUNT
0200: 0292 18      CLC
0210: 0293 69 02      ADCIM $02 ADJUST THE OFFSET
0220: 0295 30 01      BMI OVER BRANCH IF BACKWARDS BRANCH

```

```

0230: 0297 E8          INX          FORWARDS - MAKE FLAG ZERO
0240: 0298 8E 31 A6 OVER STX      SCR1  SAVE THIS ALSO
0250: 029B 18          CLC
0260: 029C 65 FE          ADC      CURAD  CALCULATE "TO" LOW-ORDER
0270: 029E AA          TAX          PUT INTO X
0280: 029F AD 31 A6      LDA      SCR1  00 OR FF, REMEMBER?
0290: 02A2 65 FF          ADC      CURADH CALCULATE "TO" HIGH-ORDER
0300: 02A4 20 B6 02      JSR      ADJUST  FIX IT IF NECESSARY
0310: 02A7 CA          DEX          TAKE BACK OFFSET
0320: 02A8 CA          DEX
0330: 02A9 8A          TXA          PUT LOW-ORDER BACK INTO A
0340: 02AA 38          SEC          RE-CALCULATE RELATIVE BRANCH
0350: 02AB ED 30 A6      SBC      SCRO
0360: 02AE 91 FE          STAIY CURAD  AND PUT IT BACK
0370: 02B0 20 CE 02      JSR      SIGNCH  GO CHECK FOR SIGN CHANGE
0380: 02B3 4C 59 02      JMP      SKIP1  GO SKIP FORWARD TO NEXT OPCODE
0390:
0400: *****
0410: * EXAMINE ADDRESS AND ADJUST IT IF NEEDED
0420: * HIGH-ORDER IS IN A
0430: * LOW-ORDER IS IN X
0440: *****
0450:
0460: 02B6 C9 80      ADJUST CMPIM $80  MAKE SURE REFERENCE NOT TOO FAR
0470: 02B8 B0 13      BCS      OUT      DONE IF TOO HIGH
0480: 02BA CD 4F A6      CMP      P1H    CHECK HIGH-ORDER FIRST
0490: 02BD D0 03      BNE      TEST2  BRANCH IF NOT EQUAL
0500: 02BF EC 4E A6      CPX      P1L    EQUAL - NEED TO CHECK LOW-ORDER ALSO
0510: 02C2 90 09      TEST2 BCC      OUT      BRANCH IF LOW
0520: 02C4 48          PHA          ELSE SAVE HIGH-ORDER ON STACK
0530: 02C5 8A          TXA          PUT LOW-ORDER INTO A
0540: 02C6 18          CLC
0550: 02C7 65 FC          ADC      ADJUST  ADD LOW-ORDER ADJUSTMENT
0560: 02C9 AA          TAX          PUT BACK INTO X
0570: 02CA 68          PLA          PULL HIGH-ORDER BACK OUT
0580: 02CB 65 FD          ADC      ADJUST  ADD IN HIGH ORDER ADJUSTMENT
0590: 02CD 60          OUT      RTS      AND RETURN
0600:
0610: *****
0620: * CHECK TO MAKE SURE SIGN
0630: * BEFORE BRANCH IS SAME AS AFTER
0640: *****
0650:
0660: 02CE 4D 31 A6      SIGNCH EOR    SCR1  SEE IF SIGNS ARE THE SAME
0670: 02D1 10 0A          BPL      SIGNOK  BRANCH IF THE SAME
0680: 02D3 48          PHA          SAVE "A" ON STACK
0690: 02D4 20 16 83      JSR      CRLFSZ  OUTPUT CURRENT ADDRESS
0700: 02D7 20 42 83      JSR      SPACE  AND A SPACE
0710: 02DA 4C 77 81      JMP      ERNOCR  AND ERROR MESSAGE
0720: 02DD 60          SIGNOK RTS      RETURN IF SIGN IS OK
0730:
0740: *****
0750: * SYM-1 FUNCTION - MINI LISTER
0760: * BY: NICK VRTIS -- LSI/CCSD -- APRIL 1979
0770: *
0780: * LIST A PROGRAM BY INSTRUCTION PER LINE
0790: *
0800: * INPUT PARMS:
0810: *      PARM1 - PROGRAM STARTING ADDRESS
0820: *      PARM2 - PROGRAM ENDING ADDRESS
0830: *****
0840:
0850: 02DE C9 15      U1      CMPIM $15  MAKE SURE ON RIGHT COMMAND
0860: 02E0 D0 04          BNE      U1ERR  BRANCH IF WRONG
0870: 02E2 E0 02          CPXIM $02  MAKE SURE 2 AND ONLY 2 PARMS GIVEN
0880: 02E4 F0 02          BEQ      U1STRT  BRANCH TO START IF CORRECT
0890: 02E6 38          U1ERR SEC
0900: 02E7 60          RTS
0910: 02E8 20 9C 82      U1STRT JSR      P2SCR  SET UP BEGINNING ADDRESS
0920:
0930: *****
0940: * LIST PROGRAM EITHER 1 AT A TIME OR "MAXRC" AT A TIME
0950: *****
0960:
0970: 02EB AD 58 A6      LISTER LDA  MAXRC  # OF LINES CONTROLLED BY "MAXRC"
0980: 02EE 8D 31 A6          STA      COUNT  SAVE IN SCRATCH AREA
0990:
1000: 02F1 20 16 83      LISTLP JSR      CRLFSZ  PUT OUT CURRENT ADDRESS

```

The addresses I used for the high and low trace limits are entries in the jump table. I picked these for two reasons. The first is that I don't use the jump table, so am not worried about changing it. The second is slightly more important. If you will note, the default values set in these locations during system reset turn out to cover normal user RAM. This means I don't have to worry about making sure they get set every time I reset the system.

There are a number of obscure SYM monitor routines used here, and some explanation of their function is in order now. Where possible, the names correspond to names in the monitor listing.

The routine P3SCR takes the two bytes from the P3 area and moves them to page zero locations \$FE and \$FF for indirect addressing. P2SCR does the same thing, but with the P2 data instead of P3. To my knowledge, there is no P1SCR or equivalent.

CRLFSZ is a very handy routine that outputs a carriage return, a line feed, and the contents of \$FF and \$FE (i.e. the current address). The routine INCCMP does a 16 bit add of 1 to the contents of CURAD, and compares the result to the value of P3. The compare is ignored in the relocate program; but for the lister, P3 has the program ending address so it knows when to quit. There is a reverse of this routine, called DECCMP, that subtracts 1 and does the compare. It isn't used in these routines, but might be handy some time.

There are two other SYM monitor locations used which are not labeled monitor addresses. The ERNOCR label is a few instructions into the ERMSG routine. It is after the carriage return and line feed subroutine jump. Unfortunately, where I enter, ERMSG has already pushed A on the stack, so always JMP to it from a subroutine and let it do the return from your subroutine, or else your stack will get out of sync.

The last address I call DBRTN. I use it in the extended trace. It is actually the last couple of instructions of the normal trace routine. It does a check of the carry and continues tracing if the carry is clear; otherwise it returns to the monitor. This works out conveniently since the routines INSTAT and DELAY return with the carry set if a key is down or the break key on the terminal has been pressed.

The remaining addresses and routines used in the programs are defined adequately in the SYM manual, so I won't bother discussing them here.

The relocate program should not be difficult to follow. The program is made

possible by the subroutine DETLEN. I have to give credit to Jim Butterfield and *The First Book of KIM* for that routine and for most of the relocate program. DETLEN not only determines the instruction length, but also classifies it as one of four types: a branch (Y=0) an absolute address reference (Y=FF) an "invalid" instruction (Y=FE) and all others (Y=number of bytes in the instruction).

The invalid opcodes detected are only those with bits 0 and 1 on. This is not all-inclusive, but it does cover quite a few of the undefined opcodes. The normal procedure for operating the program is to insert an FF after the last program statement, since the relocate program stops when it encounters an "invalid" opcode.

This sometimes catches an attempt to relocate a data area instead of a program, which is a definite no-no. The program can't tell the difference between most data and instructions, so make sure you stop it before it tries to "fix" the "addresses" in your data. If you get into the habit of collecting your data areas in one place, your programs will be easier to relocate.

If you follow the code, you will see that there is a lot more work involved in relocating a branch instruction than in fixing an absolute address reference. This is because the program has to compute the effective FROM and TO addresses before it can determine whether the relative byte count has changed.

I have also included a routine to verify that the sign (bit 7) of the new displacement is the same before and after the relocation. This routine was added shortly after the first time I relocated a backward branch into a forward branch, by overflowing the sign, and started executing one of the 6502's INMI instructions (INMI = Ignore Non-Maskable Interrupt).

The program lister was really easy to do with subroutine DETLEN available. I have a CRT running at 1200 baud, so I set the program up to list a screenfull of lines at a time, and then wait for any key before continuing with the listing. If you have a printer, or run at a slower baud rate, you might want to ignore the MAX-RC count, do a call to INSTAT after each line, and only stop when the break key is entered. Remember, INSTAT returns with the carry set if the break is entered, and clear otherwise.

The extended trace routine is probably the hardest to understand. It also requires one hardware change as outlined in the SYM manual. That change is the installation of jumpers W-24 and X-25. These enable software control of the debug flip-flops, but only up to a certain point.

```

1010:
1020: 02F4 20 42 83 CUROP JSR SPACE LEADING SPACE
1030: 02F7 20 24 03 JSR DETLEN MAKE SURE GOT CURRENT LINE LENGTH
1040: 02FA A0 00 LDYIM $00 INIT Y TO ZERO
1050:
1060: 02FC B1 FE CURRLP LDAIY CURAD GET CURRENT OPCODE
1070: 02FE 20 FA 82 JSR OUTBYT OUTPUT IT
1080: 0301 C8 INY BUMP TO NEXT BYTE
1090: 0302 CC 32 A6 CPY BYTES SEE IF DONE
1100: 0305 D0 F5 BNE CURRLP LOOP FOR CURRENT NUMBER OF BYTES
1110:
1120: 0307 20 1A 03 JSR ADVANC ADVANCE TO NEXT INSTRUCTION
1130: 030A B0 0C BCS PGMDON SEE IF TO END
1140: 030C CE 31 A6 DEC COUNT ELSE DECREASE LINE COUNT
1150: 030F 10 E0 BPL LISTLP GOT MORE TO DO IF POSITIVE
1160:
1170: 0311 20 1B 8A JSR INCHR WAIT FOR ANY CHARACTER
1180: 0314 F0 02 BEQ PGMDON EQUAL MEANS C/R AND HE WANTS QUIT
1190: 0316 D0 D3 BNE LISTER ELSE CARRY ON
1200:
1210:
1220: *****
1230: * END OF PROGRAM ENCOUNTERED - RETURN TO MONITOR
1240: *****
1250: 0318 18 PGMDON CLC CLEAR CARRY FOR OK RETURN
1260: 0319 60 RTS AND RETURN
1270:
1280: *****
1290: * ADVANCE TO NEXT INSTRUCTION
1300: *****
1310:
1320: 031A AE 32 A6 ADVANC LDX BYTES GET BYTE COUNT
1330: 031D 20 B2 82 ADVILP JSR INCCMP BUMP CURRENT ADDRESS
1340: 0320 CA DEX DECREASE COUNT
1350: 0321 D0 FA BNE ADVILP LOOP UNTIL ALL BYTES ARE COUNTED
1360: 0323 60 RTS RETURN HERE
1370:
1380: *****
1390: * DETERMINE THE INSTRUCTION LENGTH
1400: *****
1410:
1420: 0324 A0 00 DETLEN LDYIM $00 INIT Y TO ZERO
1430: 0326 B1 FE LDAIY CURAD PICK UP CURRENT OPCODE
1440:
1450: * ENTER HERE IF "A" ALREADY HAS OPCODE IN IT
1460:
1470: 0328 A8 DETLN1 TAY SAVE IN Y
1480: 0329 A2 07 LDXIM $07 GOT SEVEN TABLE ENTRIES TO CHECK
1490:
1500: 032B 98 CHKLOP TYA PUT OPCODE BACK INTO A
1510: 032C 3D 82 03 ANDX TABOUT -01 REMOVE THE DON'T CARE BITS
1520: 032F 5D 89 03 EORX TABTST -01 TEST THE REST
1530: 0332 F0 03 BEQ FOUND BRANCH IF FOUND THE MATCH
1540: 0334 CA DEX ELSE TRY NEXT ENTRY
1550: 0335 D0 F4 BNE CHKLOP UNTIL ALL ARE LOOKED AT
1560:
1570: 0337 BC 99 03 FOUND LDYX TABLEN GET LENGTH FROM TABLE
1580: 033A 8C 32 A6 STY BYTES SAVE THE LENGTH
1590: 033D BC 91 03 LDYX TABTYP NOW LOAD THE OPCODE TYPE
1600: 0340 60 RTS AND RETURN
1610:
1620:
1630: ID=03
0010:
0020:
0030: *****
0040: * ALTERNATE USER TRACE ROUTINE
0050: *
0060: * BY: NICK VRTIS -- LSI/CCSD FEBRUARY 1979
0070: *
0080: * ALTERNATE TRACE ROUTINE TO PRINT ADDITIONAL DATA
0090: *
0100: * WILL PRINT PROGRAM COUNTER-Y-X-A-FLAGS-STACK
0110: * ONLY PRINTS FOR PROGRAM ADDRESS IN RANGE OF ADDRESS
0120: * SPECIFIED BY:
0130: * A62C - EXCLUSIVE ENDING ADDRESS
0140: * (SYM DEFAULT IS 0000)

```

```

0150:      *          A626 - INCLUSIVE STARTING ADDRESS
0160:      *          (SYM DEFAULT IS 0000)
0170:      * TRACE VELOCITY IS IGNORED IF TRACE IS NOT IN RANGE
0180:      * KEYBOARD IS CHECKED AND RETURN
0190:      * IS TO MONITOR IF KEY OR BREAK
0200:      * REGARDLESS OF ADDRESS
0210:      *****
0220:
0230: 0341 AE 59 A6  USRTRA LDX  USREGS ALWAYS EXECUTES SO X IS OK
0240: 0344 AD 5A A6      LDA  USREGS +01 A WILL BE OK IF SELF TRACING
0250:
0260:      *****
0270:      * CHANGE THE FOLLOWING INSTRUCTION
0280:      * TO HIGH-ORDER OF PAGE LOCATED ON
0290:      *****
0300:
0310: 0347 C9 03          CMPIM $03  SEE IF TRACING MYSELF
0320: 0349 F0 35          BEQ  RETURN
0330: 034B CD 2D A6      CMP  THIGH +01
0340: 034E D0 03          BNE  HI
0350: 0350 EC 2C A6      CPX  THIGH
0360: 0353 B0 28      HI    BCS  NOTRAN BRANCH IF TOO HIGH
0370:
0380:      *****
0390:      * IT IS LESS THAN THE UPPER LIMIT
0400:      *****
0410:
0420: 0355 CD 27 A6      CMP  TLOW  +01 CHECK AGAINST LOWER LIMIT
0430: 0358 D0 03          BNE  LO
0440: 035A EC 26 A6      CPX  TLOW
0450: 035D 90 1E      LO    BCC  NOTRAN BRANCH IF NOT IN RANGE
0460:
0470:      * IT IS IN RANGE - OUTPUT GOODIES
0480:
0490: 035F 20 4D 83      JSR  CRLF  START ON NEW LINE
0500: 0362 20 EE 82      JSR  OUTPC
0510: 0365 A2 05          LDXIM $05
0520: 0367 BD 5A A6  DSPREG LDAX  USREGS +01
0530: 036A 20 42 83      JSR  SPACE  OUTPUT LEADING SPACE
0540: 036D 20 FA 82      JSR  OUTBYT NOW THE DATA AS 2 HEX
0550: 0370 CA          DEX
0560: 0371 D0 F4          BNE  DSPREG
0570: 0373 EC 56 A6      CPX  TV      COMPARE 0 TO TV
0580: 0376 F0 08          BEQ  RETURN  EQUAL WILL ALSO HAVE CARRY SET
0590:
0600:      * PERFORM THE DELAY ACCORDING TO TV VALUE
0610:
0620: 0378 20 5A 83  DODELA JSR  DELAY
0630: 037B B0 03          BCS  RETURN IF KEY WAS DOWN - DON'T CHECK AGAIN
0640:
0650:      * NOT IN RANGE - CHECK FOR KEY DOWN ANYWAY
0660:
0670: 037D 20 86 83  NOTRAN JSR  INSTAT CHECK FOR KEY DOWN

0690:      * RETURN WITH CARRY ON FOR RETURN TO MONITOR
0700:      * CARRY OFF TO CONTINUE TRACE
0710:
0720: 0380 4C BB 80  RETURN JMP  DBRTN  RETURN WILL CHECK CARRY
0730:
0740:      *****
0750:      * TABLES FOR DETLIN
0760:      *****
0770:
0780: 0383 0C          TABOUT =    $0C    MASKS TO REMOVE DON'T CARE BITS
0790: 0384 1F          =    $1F
0800: 0385 0D          =    $0D
0810: 0386 87          =    $87
0820: 0387 1F          =    $1F
0830: 0388 FF          =    $FF
0840: 0389 03          =    $03
0850: 038A 0C          TABTST =    $0C
0860: 038B 19          =    $19
0870: 038C 08          =    $08
0880: 038D 00          =    $00
0890: 038E 10          =    $10
0900: 038F 20          =    $20
0910: 0390 03          =    $03
0920: 0391 02          TABTYP =    $02

```

When I started writing this routine, it was only going to be a one night project. It turned out to be a project all right, but it was more than one night. In the mean time, I found the program bug that caused me to write the extended trace in the first place. It has been useful on a number of later projects, though.

Let me tell you some things about the SYM implementation of hardware debug. It all starts with a non-maskable interrupt which is generated at the completion of each instruction that is not a SYM monitor address, provided that the debug flip-flop is set. The 6502 picks up the address contained in locations \$FFFA and \$FFFB as the interrupt handler. Do to wiring "mirrors", \$FFFA and \$FFFB are actually \$A67A and \$A67B, which are system RAM addresses.

Normally, this vector contains the address of SVNMI, which is the usual trace routine. The first thing the monitor does is unprotect system RAM, and then save all the registers, flags, and program counter in the user register save area in system RAM. It then resets the debug flip-flop so that it is off. For the extended trace, this vector is changed to point to another SYM monitor routine that does the same things, but exits via an indirect jump through system RAM location TRCVEC to the user trace routine.

In theory, this means that the user routine should be able to do just about anything the monitor can do. The hard facts of life are that the debug key bounces, and the monitor does not debounce it before you get control, but it does reset the flip-flop.

This is no problem if I am in the monitor (say, waiting for input) when I press the debug key. Since the monitor does not get interrupted, by the time an interrupt is generated, the key is through bouncing, and only the interrupt is generated.

If, on the other hand, a user program is executing and I press the debug key, the extended trace routine get control before the key has finished bouncing. This means that an interrupt is generated within the extended trace and it starts tracing itself.

At first glance, the solution would seem the same as for any other bouncy input; namely, to wait for it to settle. The only problem is that the extended trace gets only ONE instruction done before the routine is interrupted. The best that I could do was check to see if it is tracing itself and exit gracefully to the monitor if so. Unfortunately, the register save area doesn't contain any more useful information, but then, there is a price for everything.

Now that we have that explanation out of the way, on to a discussion of the mechanics of the trace routine. Actually, the hardest part is making sure the carry gets set or cleared, before returning to DBRTN, so we either continue tracing or exit to the monitor. If the program is tracing itself, or if the trace velocity is zero, the return is executed immediately after a compare instruction that resulted in an equal condition which sets the carry.

If the trace velocity was not zero, then this routine uses the DELAY routine to slow down the execution rate. DELAY even checks the keyboard, via INSTAT, for a break key and sets the carry appropriately. The check of the carry is made after the jump to DELAY so that the program doesn't check the keyboard twice. The second check would probably get the opposite results if the keypad were being checked, since KEYQ debounces the keypad.

You should also note that even if the address is not in the requested range, the program does a call to INSTAT, anyway, to check for a key down or the break key. This is so you can interrupt a program outside your requested trace range. Remember, the debug key is already causing the extended trace to be invoked, so you can't stop the program with that.

The final thing to remember about the trace routine is that even for those addresses you have not selected, there are an awful lot of instructions executed before that fact is determined. Effectively, your cycle time has slowed drastically when debug is on, and I mean by orders of magnitude. This can be surprising at times, especially when the code you are bypassing initializes a two thousand byte array.

Last but not least, I would like to explain the strange code that appears at the start of the program. It comprises the ASCII commands that set up the user command vector, the MAXRC byte count, and the extended trace routine addresses. By putting them there, I only have to remember one address instead of half of a dozen. By using the SYM execute command, all the addresses get set up for me.

Don't forget to change the addresses referenced in the execute commands when you relocate these routines. Also remember that the addresses must be in ASCII, not in hex. There is also one place in the extended trace routine that must be changed to equal the high order byte of the address the routine resides at. This is so the routine can tell if it is tracing itself. It also means the program won't trace any other program on that page.

```

0930: 0392 FF      = $FF
0940: 0393 FF      = $FF
0950: 0394 01      = $01
0960: 0395 01      = $01
0970: 0396 00      = $00
0980: 0397 FF      = $FF
0990: 0398 FE      = $FE
1000: 0399 02      = $02
1010: 039A 03      = $03
1020: 039B 03      = $03
1030: 039C 01      = $01
1040: 039D 01      = $01
1050: 039E 02      = $02
1060: 039F 03      = $03
1070: 03A0 03      = $03
1080:
1090:
1100:
1110:
1120:
1130: 03A1      DBRTN *
1140: 03A1      ERNOCR *
1150: 03A1      P2SCR *
1160: 03A1      P3SCR *
1170: 03A1      INCCMP *
1180: 03A1      OUTPC *
1190: 03A1      OUTBYT *
1200: 03A1      CRLFSZ *
1210: 03A1      SPACE *
1220: 03A1      CRLF *
1230: 03A1      DELAY *
1240: 03A1      INSTAT *
1250:          OR ANY KEY DOWN)
1260: 03A1      INCHR *
1270:
1280:
1290:
1300: 03A1      TLOW *
1310: 03A1      THIGH *
1320: 03A1      SCRO *
1330: 03A1      SCR1 *
1340: 03A1      BYTES *
1350: 03A1      COUNT *
1360: 03A1      P3L *
1370: 03A1      P3H *
1380: 03A1      P2L *
1390: 03A1      P2H *
1400: 03A1      P1L *
1410: 03A1      P1H *
1420: 03A1      ENDAD *
1430:
1440: 03A1      TV *
1450: 03A1      LSTCOM *
1460: 03A1      MAXRC *
1470: 03A1      USREGS *
ID=

```

TABLEN =

PGMEND =

 * SYM SYSTEM ROUTINE ENTRY POINTS AND RAM ADDRESSES

```

DBRTN * $80BB CHECK CARRY & TRACE OR MONITOR
ERNOCR * $8177 "ERXX" W/O CR/LF -- JUMP TO ONLY
P2SCR * $829C PUT "PARM2" INTO "CURAD"
P3SCR * $82A7 PUT "PARM3" INTO "CURAD"
INCCMP * $82B2 BUMP "CURAD" & COMPARE TO PARM3
OUTPC * $82EE OUTPUT USER PROGRAM COUNTER
OUTBYT * $82FA PRINT A (TWO HEX DIGITS)
CRLFSZ * $8316 OUTPUT CR/LF AND "CURAD"
SPACE * $8342 OUTPUT ONE SPACE
CRLF * $834D OUTPUT CR/LF
DELAY * $835A DELAY ACCORDING TO TV
INSTAT * $8386 GET KEY STATUS (BREAK
OR ANY KEY DOWN)
INCHR * $8A1B GET ASCII CHAR VIA "INVEC"
*****
TLOW * $A626 TRACE LOW ADDRESS
THIGH * $A62C TRACE HIGH ADDRESS
SCRO * $A630 SYSTEM SCRATCH AREA 0
SCR1 * $A631 SYSTEM RAM SCRATCH AREA 1
BYTES * $A632 SYSTEM RAM SCRATCH AREA 2
COUNT * SCR1 USE SCRATCH AREA 1
P3L * $A64A INPUT PARAMETER VALUES
P3H * $A64B
P2L * $A64C
P2H * $A64D
P1L * $A64E
P1H * $A64F
ENDAD * P3L ENDING ADDRESS IS IN P3 AREA
TV * $A656 TRACE VELOCITY
LSTCOM * $A657 COMMAND END INDICATOR
MAXRC * $A658 MAXIMUM RECORD/BYTES FOR OUTPUT
USREGS * $A659 TRACE HOLD OF USER REGISTERS

```

SYMBOL TABLE 2000 21C8

ADJUST 02B6	ADJUSH 00FD	ADJUST 00FC	ADVANC 031A
ADVILP 031D	BRANCH 0283	BYTES A632	CHKLOP 032B
COMERR 0231	COUNT A631	CRLF 834D	CRLFSZ 8316
CURAD 00FE	CURADH 00FF	CUROP 02F4	CURRLP 02FC
DBRTN 80BB	DELAY 835A	DETLEN 0324	DETLNQ 0328
DODELA 0378	DSPREG 0367	ENDAD A64A	ERNOCR 8177
FIXSBY 0270	FOUND 0337	GETOP 0252	HI 0353
INCCMP 82B2	INCHR 8A1B	INITCO 0200	INSTAT 8386
LISTER 02EB	LISTLP 02F1	LO 035D	LSTCOM A657
MAXRC A658	NOTRAN 037D	OUTBYT 82FA	OUTPC 82EE
OUT 02CD	OVER 0298	PGMDON 0318	PGMEND 03A0
PQH A64F	PQL A64E	PRH A64D	PRL A64C
PRSCR 829C	PSH A64B	PSL A64A	PSSCR 82A7
QUITDO 0261	RETURN 0380	SCRP A630	SCRQ A631
SIGNCH 02CE	SIGNOK 02DD	SKIPQ 0259	SPACE 8342
TABLEN 0399	TABOUT 0383	TABTST 038A	TABTYP 0391
TESTR 02C2	THIGH A62C	TLOW A626	TRIPLE 025E
TV A656	UP 0233	UPCOMM 023A	UQ 02DE
UQERR 02E6	UQSTRT 02E8	USREGS A659	USRTRA 0341



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If your microcomputer board uses the 6520 Peripheral Interface Adapter for an I/O port, you might consider replacing it with a 6522 Versatile Interface Adapter. For the two dollars increase in price you get all the functions of the 6520 plus two timers, a shift register, input data latching, and a much more powerful interrupt system.

A block diagram of the VIA is shown in Figure 1. The 6522 appears to the CPU as sixteen memory locations, compared to four for the 6520. Table 1 shows how the various registers are addressed using the register select pins. In some cases, accessing a register triggers another function such as resetting an interrupt flag or starting the timer.

The timers are loaded with data and then decremented at the system clock rate to create a delay. This can be used to generate interrupts at preset intervals.

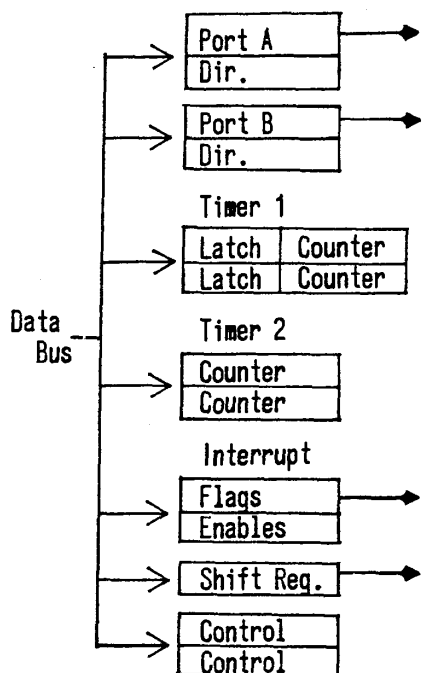


Figure 1: Block Diagram of the 6522

Table 1: 6522 Register Address List

RS3	RS2	RS1	RS0	FUNCTION
L	L	L	L	I/O port B
L	L	L	H	I/O port A
L	L	H	L	Data direction B
L	L	H	H	Data direction A
L	H	L	L	Timer 1 counter low byte
L	H	L	H	Timer 1 counter high byte
L	H	H	L	Timer 1 latch low byte
L	H	H	H	Timer 1 latch high byte
H	L	L	L	Timer 2 low byte
H	L	L	H	Timer 2 high byte
H	L	H	L	Shift register
H	L	H	H	Timer and shift register control
H	H	L	L	I/O handshake control
H	H	L	H	Interrupt flags
H	H	H	L	Interrupt enables
H	H	H	H	I/O port A

Another use is to connect an amplifier and speaker to the shift register output. By storing a 11110000 or 11001100 in the shift register and placing it in the free running mode, square waves at audio frequencies are produced. BASIC can then POKE constants to timer 2 to produce various audio tones. You can create electronic music, or add sound effects to those mute game programs. In fact, this scheme is used for the PET sound effects.

The timers can be set to cause interrupts at equally spaced time intervals. This saves the CPU the chore of keeping time or chasing its tail in loops to create delays. I found the timed interrupt very convenient in writing a single-step machine language debugging program. The timer is set so the CPU can just escape from the monitor and execute one step of the main program before another interrupt forces it back to the monitor. A recent issue of MICRO gives details of using the 6522 timers with a SYM computer.

So how do you install this super chip in your system? Figure 2 compares the pin-outs of the 6520 and the 6522. Thirty-six of the forty pins are identical, so that is a good start. However changes must be made to your circuit board at pins 21, 22, 37 and 38. The 6522 needs 4 address lines compared to 2 for the 6520. I jumpered RS0 and RS1 to address lines 2 and 3 somewhere on the CPU board. To reduce foil cutting, I left RS2 and RS3 connected to address 0 and 1. You will have to make your own list of register addresses depending how you connect the RS lines to your address buss. IRQ and R/W must be re-jumped to the proper pins. My CPU board did not use CS0, so this was no loss.

I made this modification on an OSI 500 CPU board (Kilobaud March 1979). After reading the Trouble Shooter's Corner (Kilobaud September 1978), I was very apprehensive about taking on this project. However the OSI board has no "bogus" clock pulsus running around, so I had no trouble.

Any of seven events can cause an interrupt and set a flag in the interrupt flag register. The shift register rate is controlled either by timer 2 or by an external clock. Two control registers allow selection of the many options available in the 6522 VIA. More details of the 6522 can be obtained from Synertek, P.O. Box 552, Santa Clara CA 95052.

So what does the 6522 gain you as far as programming? Well, the shift register can be used as a serial output port to drive a Teletype or printer. The baud rate is software controlled by the constant stored in timer 2.

PA,PB = I/O Port
CA,CB = Handshake Control
RS = Register Select (Address)
RES = Reset
D = Data Bus
CS = Chip Select
IRQ = Interrupt

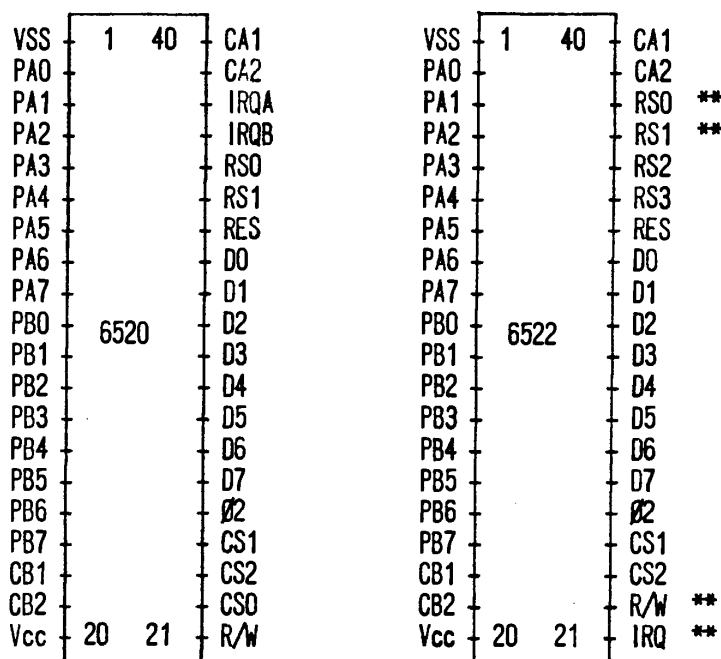


Figure 2: Pin-outs of the 6522 VIA and 6520 PIA

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No more lost files, missing data or elusive end of file marks! Now that great cassette I/O capability can be put to work.

At first glance it would appear that cassette data storage on the Commodore PET would be a snap. Upon trying it, you soon discover otherwise. Three major problems soon emerge to frustrate the uninitiated. The PET does not read back all of the data you wrote on the tape. It misses the end of file mark, causing the system to crash, and occasionally it even refuses to find a file which you have written.

The first two problems are related. An end of file mark is, after all, data, so if the PET is skipping data it could (and does!) just skip the end of file mark. Fixing the problem of skipping data will fix the problem of missing the end of file.

The PET writes data onto the cassette tape in blocks of 192 characters, including carriage returns. The cassette

motor is turned off in between writing blocks. Before writing the next block the motor must be turned on, and time allowed for the tape to come up to its steady, proper speed. Apparently, when the PET operating system was written, the cassette decks came up to speed much faster than the cassette units supplied with production PETs.

Because of this, the pause (interblock gap) is insufficient. When the PET attempts to read the block back, data starts before the tape is up to speed, resulting in the first few bytes of the block being garbled. Unfortunately, those few bytes are what identify the block as data rather than noise. As a result, the block is ignored completely and the PET keeps searching until it comes to the next block. Of course, the tape is at its correct speed by now, so this block is

read properly. The bottom line is that you lose every other block of data!

To solve this problem you need to funnel all of your output to tape through a subroutine. The subroutine counts how many characters have been written and placed into the tape buffer. When it detects that the 192nd character is about to be written, it should reset its counter to zero, start up the cassette motor, and pause 1/6 second before allowing the character to be written. To start cassette #1, POKE 59411,53. For cassette #2, it's POKE 59456,207.

Use of this subroutine will eliminate the problem of skipped blocks. It will also insure that the end of file mark is not missed.

The problem of unrecognized files is another operating system idiosyncrasy, fortunately much simpler to fix. According to Commodore, upon occasion the system will not properly initialize the tape buffer before opening a file. This causes the data to be placed in the wrong place in the memory or buffer. The system can't recognize the data when it opens for input because it just can't find it! The fix is simple. For tape unit #1, POKE 243,122; POKE 244,2 before opening the file. For tape unit #2, POKE 243,58; POKE 244,3 before opening. These POKES initialize the pointers and eliminate the problem.

The subroutines shown illustrate one way to use the methods just described. Set PR or PR\$ equal to the variable which you wish to print and jump to the appropriate subroutine entry point. Do not forget to write an interblock gap before closing the file.

Please note that even though you have stored numbers as ASCII strings on the tape, this is what the PET does anyway! You can still read it as a number. This information should help you employ the great file handling capabilities built into your PET.

```
100 REM PRINT NUMERIC
110 PR$ = STR$(PR)
120 REM PRINT STRING
130 LN% = LN% + LEN(PR$) + 1
140 IF LN% = 191 THEN LN% = 0 : GOSUB 180
150 PRINT#1,PR$
160 RETURN
170 REM INTERBLOCK GAP
180 DT = TI
190 POKE 59411,53 : IF DT + 10 = TI GOTO 190
200 RETURN
```

Tokens

E. D. Morris Jr.
3200 Washington Street
Midland, MI 48640

The speed and efficiency of Microsoft BASIC result from an insightful software design technique.

Microsoft BASIC used in the PET and OSI computers is fast and memory efficient. One reason for this is that the BASIC commands are abbreviated through use of tokens. For example, if you write the BASIC program:

```
10 IFA = BTHEN GOSUB 99
```

you will not find the words IF, THEN or GOSUB should you PEEK into the BASIC program. If OSI owners with BASIC in ROM run the following in immediate mode:

```
FOR X = 768 TO 781
PRINT PEEK(X)
NEXT X
```

The BASIC line will look like this:

```
0 14 3 10 0 138 65 171 66 160 140 57 57 0
```

So let's try to pick this apart and see what happened. The leading and trailing 0's are delimiters to separate BASIC lines. The "14 3" in the second and third byte means the next BASIC line starts at

memory location $14 + 3 \times 256 = 782$ (decimal). The "10 0" in the next two bytes indicates this is BASIC line $10 + 0 \times 256 = 10$. If you look in a table of ASCII codes, 65, 66 and 57 are the ASCII values for A, B and 9.

Thus our code deciphering so far yields:

```
0 14 3 10 0 138 65 171 66 160 140 57 57 0
 \ / \ \ / \ /
782 #10 A B 9 9 END
```

A little inspection of what is still missing indicates that somehow, "138" means IF, "171" means EQUALS, "160" means THEN and "140" means GOSUB. These are the tokens used in Microsoft BASIC.

The following program will decode tokens for OSI users.

```
10 REM
20 INPUT X
30 POKE 773,X
40 LIST 10
```

Start the program via "RUN 20" to skip over the first line. Then input a number between 65 and 195. For example, if you INPUT a 138, line 10 will now contain an IF.

Table 1 is a list of tokens for the OSI system. This will help in PEEKing around your BASIC programs. You could even write a program that rewrites itself. PET owners: Don't worry, I haven't forgotten you. To look at the first line of the BASIC program, run in immediate mode:

```
FOR X = 1024 TO 1037
PRINT PEEK(X)
NEXT X
```

Line 30 of the token decoder program should be changed to:

```
30 POKE 1029,X
```

You will find the PET tokens are not identical to OSI's. So I leave it to you to build your own list.

Editor: Thanks to Alvin L. Hooper, 207 Self St., Warner Robbins, GA 31093 who submitted an equivalent table of OSI BASIC tokens.

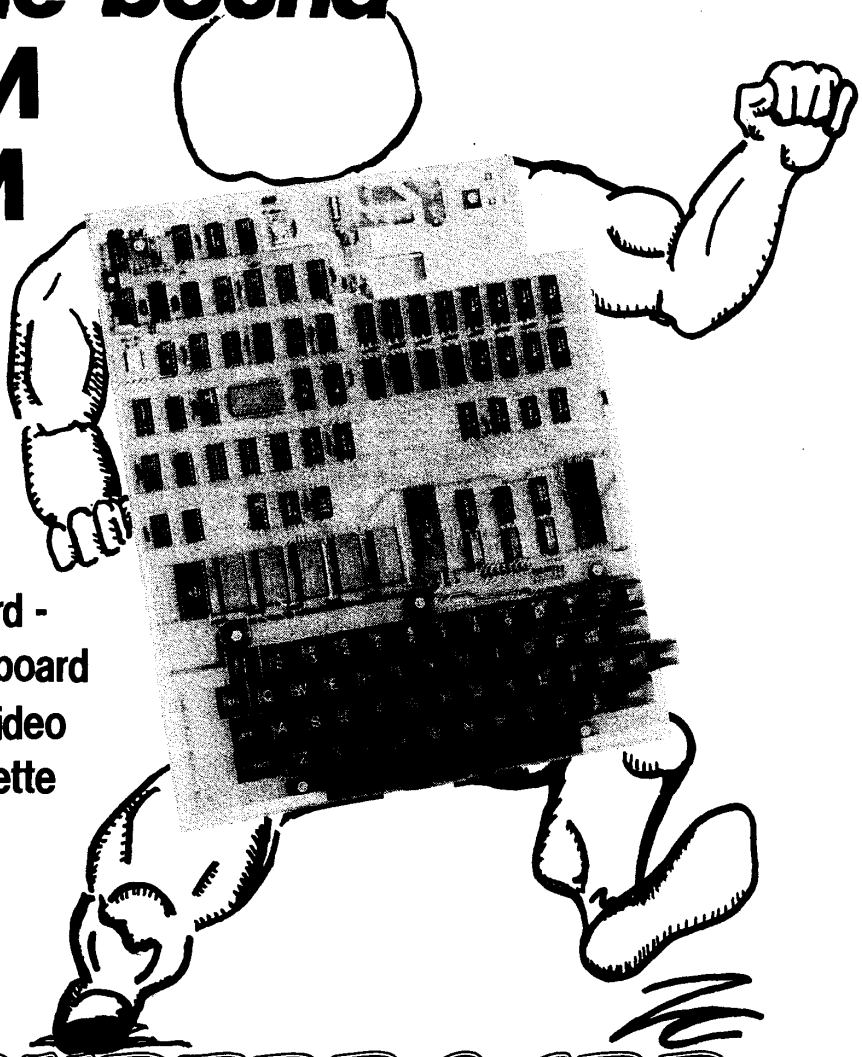
Table 1: OSI BASIC Token Index

151	PRINT	128	END	174	INT
152	CONT	129	FOR	175	ABS
153	LIST	130	NEXT	176	USR
154	CLEAR	131	DATA	177	FRE
155	NEW	132	INPUT	178	POS
156	TAB(	133	DIM	179	SQR
157	TO	134	READ	180	RND
158	FN	135	LET	181	LOG
159	SPC(	136	GOTO	182	EXP
160	THEN	137	RUN	183	COS
161	NOT	138	IF	184	SIN
162	STEP	139	RESTORE	185	TAN
163	+	140	GOSUB	186	ATN
164	-	141	RETURN	187	PEEK
165	*	142	REM	188	LEN
166	/	143	STOP	189	STR\$
167	(power of)	144	ON	190	VAL
168	AND	145	NULL	191	ASC
169	OR	146	WAIT	192	CHR\$
170	>	147	LOAD	193	LEFT\$
171	=	148	SAVE	194	RIGHT\$
172	<	149	DEF	195	MID\$
173	SGN	150	POKE	197-211	BASIC Error Codes

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A Better LIFE for Your APPLE

An enhancement to LIFE makes it easy to establish an initial pattern, monitor successive generations, and modify the pattern at any particular generation. This input technique is cursor oriented and keyboard driven to facilitate entering complex patterns.

L. William Bradford
7868 Naylor Avenue
Los Angeles, CA 90045

It was a distinct pleasure to see Richard F. Suitor's article, *Life For Your Apple* in MICRO 8:11. Since my introduction to this mathematical game through a program written by an associate, I have derived a great deal of pleasure from watching the evolution of many "life" forms. I was quite taken by the execution speed of Mr. Suitor's program, but I feel that his method of designating a living cell is awkward, especially for large complex patterns.

I would like to pass on to other MICRO readers a technique employed by W.P. Hennessy in that very first LIFE program I used. While I have made substantial changes to make the program easier and a little more versatile, the technique remains the same.

Instead of using the inconvenient INPUT X,Y, the operator may move a cursor about the screen, depositing or erasing cells, or moving without disturbing cells. The cursor is a single white "brick" whose motion is controlled by depressing one of the keys described below:

KEY	DIRECTION OF MOTION
N,U	Bottom to Top
E,R	Left to Right
S,D	Top to Bottom
W,L	Right to Left

The keys N, E, W, and S have a very different function than the U, D, R, and L

keys, since the former move the cursor without affecting the screen, while the latter cause a cell to be deposited or erased from the screen. In every case, the cursor moves one space per keystroke.

The U, D, R, and L keys are used in two modes, the "write" mode and the "erase" mode, with "write" mode being the default. As an example, suppose that the program is in the default mode, and the operator depresses the U key. The cursor will move one space up, leaving a live cell in the square just vacated. The erase mode is entered by depressing the ESC key, and the write mode re-entered by depressing the O (as in orange) key.

Assuming that the cursor is centered on a live cell, and that the program is in the erase mode, depressing the U key will cause the live cell to be deleted and the cursor to move up. There is no effect on unoccupied cells. If this sounds complicated at first, it is nonetheless simple in practice.

Once a pattern has been entered, the RETURN key is depressed to start the program. I have retained the heart of Mr. Suitor's BASIC program which sets up the timing loops and calls the machine language subroutines. I have made some slight changes to his routine to generate a random pattern by setting up a default

grid size and using a different randomization.

In the present version of the program, execution will stop briefly after some number of generations. The number of generations is a function of the default timer loop interval which the operator designates. During the pause, the program will be examining the keyboard, looking for certain keys. These keys and their functions are described in Table 1.

The duration of the pause can be controlled by changing the value of the variable JK at statement 315. If the user should wish to pause after each generation, the following statements will effect that change:

```
306 GOSUB 315: NEXT I
350 RETURN
366 IF IN = 82 THEN RETURN
```

The program also allows the operator to run without any pauses provided that he answers in the affirmative to the question at statement 14. In general, this is the way that I run the program.

The APPLE LIFE fan will find that the code presented here, when coupled with Richard Suitor's excellent machine language code, will provide many hours of entertainment and mental stimulation. John Conway's game of LIFE is surely one of the more exciting uses of the personal computer.

Table 1: Single Key Functions

KEY	FUNCTION
P	Stop execution and wait
K	Stop and clear screen, get new pattern
X	Exit to Basic
M	Stop to allow modification of pattern
G	Restart execution

```

0 TEXT : GOTO 2
1 Q= PEEK (-16384): IF Q<127 THEN
  1:Q=Q-128: POKE -16368,0: RETURN
2 CALL -936: VTAB 9: TAB 15: PRINT
  "** LIFE **": PRINT : PRINT
3 PRINT " A VERSION OF JOHN CONWAY
  'S GAME OF LIFE": PRINT
4 TAB 10: PRINT "WRITTEN FOR THE A
  PPLE II"
5 VTAB 15: PRINT " ASSEMBLY LANGUA
  GE ROUTINES WRITTEN BY RICHARD
  F SUITOR AND PUBLISHED IN ISSUE
  "
6 PRINT "NO. 8 OF 'MICRO' COPYRIGH
  T 1978": PRINT "BASIC ROUTINES B
  Y L.W. BRADFORD 1978"
7 VTAB 22: INPUT "DO YOU WANT INST
  RUCTIONS?",XS
8 CALL -936
9 IF XS="Y" THEN 2000
10 TEXT : GR
12 ZZ=0
14 INPUT "DO YOU WANT THE PROGRAM T
  O RUN WITHOUT EXTERNAL COMMAND
  S",XS
15 IF XS="Y" AND XS#"N" THEN 14
  : IF XS="N" THEN 20: IF XS=
  "Y" THEN ZZ=1
20 CALL -936
21 INPUT "ENTER DEFAULT VALUE FOR T
  IMER INTERVAL",KX1
32 INPUT "DO YOU WANT A RANDOMLY OC
  CUPIED SPACE",XS
33 IF XS="Y" AND XS#"N" THEN 32
  : IF XS="N" THEN 100
40 INPUT " STANDARD GRID SIZE (0<X<
  39,0<Y<47) ",XS
41 IF XS="Y" AND XS#"N" THEN 40
  : IF XS="N" THEN 54
42 J1=1:J2=46:I1=1:I2=38: GOTO
  59
54 INPUT "ENTER X DIRECTION LIMITS
  (0 TO 39)",I1,I2
55 IF I1<0 OR I2>39 THEN 54
56 INPUT "ENTER Y DIRECTION LIMITS
  (0 TO 47)",J1,J2
57 IF J1<0 OR J2>47 THEN 56
59 SI= RND (4)+1:SJ= RND (3)+1

60 GR : POKE -16302,0
61 CALL -1998
62 FOR I=I1 TO I2 STEP SI
63 FOR J=J1 TO J2 STEP SJ

```

```

64 COLOR=11:X= RND (2)+1:X=X*(
  RND (2))+1: IF RND (X) THEN
  COLOR=0
65 PLOT I,J
66 NEXT J
67 NEXT I
68 GOTO 292
100 GR : POKE -16302,0
101 COLOR=0
105 FOR JK=0 TO 39: VLIN 0,47 AT
  JK
106 NEXT JK
110 LIVE=11:DEAD=0:CURS=15:TEMP=
  LIVE
115 COLOR=0: FOR X=1 TO 38: VLIN
  1,46 AT X: NEXT X
120 X=18:Y=23
125 SC1= SCRNX(X,Y)
128 COLOR=CURS: PLOT X,Y
130 GOSUB 1
132 IF Q=27 THEN TEMP=0: IF Q=79
  THEN TEMP=11: IF Q=27 OR Q=
  79 THEN 130
133 COLOR=TEMP
134 IF Q=69 OR Q=87 OR Q=83 OR
  Q=78 THEN COLOR=SC1
136 PLOT X,Y
140 IF Q=13 THEN 290
142 IF Q=32 THEN 200
144 IF Q=69 OR Q=82 THEN 200
146 IF Q=87 OR Q=76 THEN 210
148 IF Q=83 OR Q=68 THEN 220
150 IF Q=78 OR Q=85 THEN 230
160 FOR JZ=1 TO 10
161 J= PEEK (-16336): NEXT JZ
162 GOTO 125
200 X=X+1: IF X>38 THEN X=38: GOTO
  125
210 X=X-1: IF X<1 THEN X=1: GOTO
  125
220 Y=Y+1: IF Y>46 THEN Y=46: GOTO
  125
230 Y=Y-1: IF Y<1 THEN Y=1: GOTO
  125
290 COLOR=0: PLOT X,Y
292 GOTO 307
294 FOR I=1 TO K3
296 CALL 2088
298 FOR K=1 TO K1: NEXT K
300 CALL 2265
302 FOR K=1 TO K2: NEXT K
306 NEXT I
307 KX= PDL (0)-10
308 IF KX>240 THEN KX=KX1
309 IF KX<0 THEN KX=0
310 K2=KX*2:K1=KX*6
311 K3=500/(K1+50)+1
312 IF ZZ=1 THEN 294
315 JK=100
320 FOR NM=1 TO JK
325 IN= PEEK (-16384)
330 IF IN>127 THEN 360
335 POKE -16368,0
340 NEXT NM
352 GOTO 294
360 IN=IN-128
365 POKE -16368,0
369 IF IN=77 THEN 120
370 IF IN=75 THEN 10
372 IF IN=71 THEN 294
373 IF IN=80 THEN 400
374 FOR IJ=1 TO 20
375 KK= PEEK (-16336)
376 NEXT IJ
380 IF IN=88 THEN 1000
400 IN= PEEK (-16384)

```

```

410 IF IN>127 THEN 360
415 POKE -16368,0
420 GOTO 400
1000 TEXT : CALL -936
1001 END
2000 VTAB 3: PRINT " YOU' GENERATE A S
    ET OF 'LIVE' CELLS": PRINT
    "BY MOVING THE CURSOR WITH THE"
    : PRINT "KEYS DESCRIBED BELOW"
    : PRINT
2001 PRINT " IN THE 'WRITE' MODE THE
    SE": PRINT "CHARACTERS GENERATE
    A LIVE CELL": PRINT
2002 PRINT " IN THE 'ERASE' MODE THE
    SAME": PRINT "CHARACTERS ERASE
    A LIVE CELL"
2003 PRINT : PRINT "YOU START OUT IN
    THE 'WRITE' MODE"
2004 PRINT "AND STAY THERE UNTIL YOU
    HIT 'ESC'"
2005 PRINT : PRINT "TYPE A 'O' TO RE-
    ENTER THE 'WRITE' MODE": PRINT

2006 PRINT "U=UP D=DOWN R=RIGHT L=LEF
    T": PRINT
2007 PRINT "TYPE ANY KEY TO CONTINUE"
    : GOSUB 1
2008 CALL -936: VTAB 2
2009 PRINT " TO MOVE WITHOUT WRITING"
    : PRINT " OR ERASING ANYTHING"

2010 PRINT "USE THE FOLLOWING CHARACT
    ERS"
2011 PRINT : PRINT "N=UP S=DOWN E=RI
    GHT W=LEFT": PRINT
2012 PRINT "WHEN FINISHED, HIT 'RETUR
    N'": PRINT

```



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```

2020 PRINT "AFTER EACH GENERATION, YO
    U MAY,"
2021 PRINT "BY USING THE APPROPRIATE
    KEY"
2022 PRINT : PRINT "PAUSE (TYPE A 'P'
    ) OR": PRINT
2024 PRINT "CONTINUE FROM THE GENERAT
    ION ON THE"
2025 PRINT "SCREEN (TYPE A 'G') "
    : PRINT
2026 PRINT "RETURN TO BASIC TYPE AN '
    X' ": PRINT
2027 PRINT "TYPE ANY KEY TO CONTINUE"
    : GOSUB 1: CALL -936
2028 PRINT "MODIFY THE PRESENT PATER
    N (TYPE AN 'N')"
2029 VTAB 4: PRINT "OR TYPE A 'K' TO
    START A NEW GAME"
2030 VTAB 8: PRINT "AFTER YOU HAVE HI
    T 'S', YOU MAY TYPE": PRINT

2031 TAB 7: PRINT "N,P,G,K, OR X"
    : PRINT
2040 PRINT
2042 PRINT " AN ADDITIONAL FACILITY O
    F A RANDOMLY": PRINT "OCCUPIED S
    PACE IS ALLOWED"
2045 PRINT : PRINT
2048 PRINT "TYPE ANY KEY TO CONTINUE"
    : GOSUB 1
3000 CALL -936
3035 PRINT : PRINT : PRINT "TYPE ANY
    KEY TO START THE GAME": GOSUB
    1
3036 GOTO 10

```



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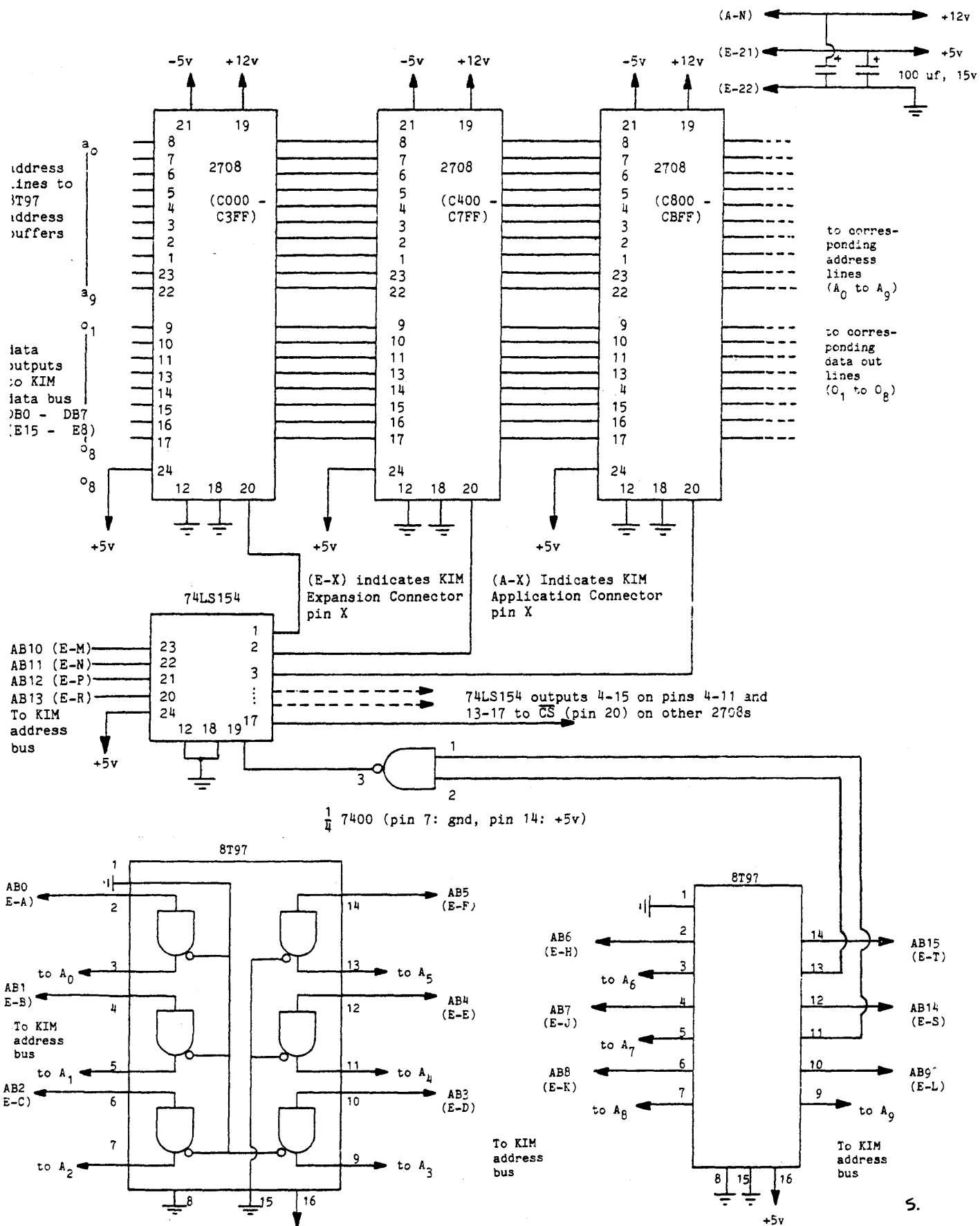
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Whether you are programming in BASIC or assembly language, a memory map helps save time, reduce program size and improve performance. This is the most complete and up to date APPLE memory map ever published.

To get the most out of an APPLE, or any other computer with limited resources, it is important to know a good deal about the hardware and software environment.

When one graduates from simple programs to more ambitious programs involving careful control of man-machine interaction, analog to digital or digital to analog conversion, extensive use of computer graphics, the control of external devices, database management, sorting, word-processing or any of a wide variety of interesting tasks, this knowledge tends to become more important. When (and if) one gets into real time programming, adding his own specialized interfaces, performs activities where one must get the absolute maximum speed or gets into other situations where machine language programming is appropriate, it becomes critical.

Not every serious programmer needs to become a machine language level programmer. However, good programmers know that when the computer is running their programs there is a good deal of machine language code in the machine providing an operating environment for their programs. This operating environment typically includes the system monitor, a BASIC interpreter and possibly a disk operating system (DOS) and/or extra ROM packages.

When one looks at interesting programs described in magazines and user group newsletters, he finds that these programs often contain PEEKs, POKEs and CALLs. These are commands which are extensions of BASIC (or other higher

level languages). They are provided to allow one to interface with the computer hardware, operating environment software, and other machine language programs or subprograms.

PEEKs, POKEs and CALLs all refer to memory locations which are identifiable as to what they contain or what they do. a PEEK examines the contents of a specified memory location and allows one to use that content in a program. POKE changes the contents of a designated memory location to some specified value. It can be used to change parameters of the operating environment or to set up or change pieces of program or data. A CALL transfers program control to a particular memory location and sets up a return linkage for transfer back to the CALLing routine in the user's program.

Pieces of the monitor or some other parts of the operating environment can often be accessed via CALLs, POKEs and PEEKs to modify system operation or to perform desired functions without the necessity of additional code. Usually this code has been carefully written in machine language and optimized by good programmers, so it runs faster and takes less space or less computer time than the same function would require if programmed totally by the user.

A programming manual intended for serious programmers should supply some sort of memory map and information about the most important and frequently used PEEKs, POKEs and CALLs. A good memory map can show the user where he can get information from the

computer, what potentially useful software is available but perhaps hidden away inside the computer, and the "hooks" provided to perform a wide variety of functions by means of CALLs, POKEs and/or PEEKs. Often it becomes the most well-worn section of the manual. Once programmers begin using it as a source of information, they begin to wish for a more complete atlas which will let them find more and more information and guide them in their own explorations inside the computer and its software.

The memory map presented here was developed initially as a programming aid for my own personal programming. Important sources of information for its creation included the *APPLESOFT II Manual*, the *APPLE Reference Manual*, *WOZPAC* and various issues of *MICRO*, *Call-Apple* and *NEAT* as well as my own investigations inside the computer.

The map is being circulated for comment, correction and modification by many of the more active members of the New England Apple Tree User's Group. They have suggested valuable changes, corrections and additions. Inevitably there will still be errors and omissions. For these I beg your indulgence.

This memory atlas is stored on-line on the Dartmouth Timeshare System in a database which can be used for selective retrieval and report generation using standard database management software. The author would appreciate corrections or suggested changes or additions. Please mail them to him at Hinman, Box 6166, Dartmouth College, Hanover, NH 03755.

HEXLOC	DECLOC	NAME	USE
\$0000-\$00FF	0-255		HARDWARE PAGE ZERO
\$0000-\$0005	0-5		JUMP INSTRUCTIONS TO CONTINUE IN APPLESOFT
\$0000-\$0001	0-1	ROL~ROH	SWEET-16 (16-BIT INTERPRETER) REGISTER RO
\$0000	0	LOCO	MONITOR MEMORY LOCATION 'LOCO'
\$0001	1	LOC1	MONITOR MEMORY LOCATION 'LOC1'
\$000A-\$000C	10-12		LOCN FOR USR FUNCTION'S JUMP INSTRUCTION
\$000D-\$0017	13-23		GENERAL PURPOSE COUNTERS/FLAGS FOR APPLESOFT
\$001A-\$001B	26-27		HI-RES GRAPHICS ON-THE-FLY SHAPE POINTER
\$001A-\$001B	26-27	SHAPEL~SHAPEH	HIRES POINTER TO SHAPE LIST
\$001C	28		HI-RES GRAPHICS ON-THE-FLY COLOR BYTE
\$001C	28	HCOLOR1	HIRES RUNNING COLOR MASK
\$001D	29	COUNTH	HI-RES GRAPHICS HIGH-ORDER BYTE OF STEP COUNT FOR LINE
\$001E-\$001F	30-31	R15L~R15H	SWEET-16 (16-BIT INTERPRETER) REGISTER R15
\$0020-\$004F	32-79		APPLE II SYSTEM MONITOR RESERVED LOCATIONS
\$0020	32	WNDLEFT	SCROLLING WINDOW: LEFT SIDE (0-39 OR \$0-\$27)
\$0021	33	WNDWDTH	SCROLLING WINDOW: WIDTH (1-40 OR \$1-\$28)(WNDLEFT+WNDWDTH<40)
\$0022	34	WNDTOP	SCROLLING WINDOW: TOP LINE (0-23 OR \$0-\$16)
\$0023	35	WNBDM	SCROLLING WINDOW: BOTTOM LINE (0-23 OR \$0-\$16)(WNBDM:WNDTOP)
\$0024	36	CH	CURSOR: HORIZONTAL POSITION (0-39 OR \$0-\$27)
\$0025	37	CV	CURSOR: VERTICAL POSITION (0-23 OR \$0-\$17)
\$0026-\$0027	38-39	GBASL~GBASH	LO-RES GRAPHICS POINTER TO LEFTMOST BYTE OF CUR. PLOT LINE
\$0026-\$0027	38-39	HBASL~HBASH	HI-RES GRAPHICS ON-THE-FLY BASE ADDRESS
\$0028-\$0029	40-41	BASL~BASH	MONITOR BASE ADDRESS POINTER
\$002A-\$002B	42-43	BAS2L~BAS2H	MONITOR BASE ADDRESS POINTER 2
\$002C	44	H2	LOW RES COLOR GRAPHICS H2
\$002C	44	LMNEM	MONITOR MEMORY LOCATION 'LMNEM'
\$002C-\$002D	44-45	RTNL~RTNH	MONITOR RETURN POINTER
\$002D	45	V2	LOW-RES COLOR GRAPHICS V2
\$002D	45	RMNEM	MONITOR MEMORY LOCATION 'RMNEM'
\$002D	45	V2	MONITOR MEMORY LOCATION 'V2'
\$002E	46	MASK	LOW-RES COLOR GRAPHICS MASK
\$002E	46	CHKSUM	MONITOR MEMORY LOCATION 'CHKSUM'
\$002E	46	FORMAT	MONITOR & MINIASSEMBLER MEMORY LOCATION 'FORMAT'
\$002F	47	LASTIN	MONITOR MEMORY LOCATION 'LASTIN'
\$002F	47	LENGTH	MONITOR & MINIASSEMBLER MEMORY LOCATION 'LENGTH'
\$002F	47	SIGN	MONITOR MEMORY LOCATION 'SIGN'
\$0030	48	COLOR	LO-RES COLOR GRAPHICS COLOR (FOR PLOT/HLIN/VLIN FUNCTIONS)
\$0030	48	HMASK	HI-RES GRAPHICS HMASK ON-THE-FLY BIT MASK
\$0031	49	MODE	MONITOR & MINIASSEMBLER MEMORY LOCATION 'MODE'
\$0032	50	INVFLG	VIDEO FORMAT CONTROL: 255(\$FF)=NORMAL; 127(\$7F)=FLASHING; 63(\$3F)=INV
\$0033	51	PROMPT	PROMPT CHARACTER: PRINTED ON GETLN CALL
\$0034	52	YSAV	MONITOR & MINIASSEMBLER MEMORY LOCATION 'YSAV'
\$0035	53	YSAV1	MONITOR MEMORY LOCATION 'YSAV1'
\$0035	53	L	MINIASSEMBLER MEMORY LOCATION 'L'
\$0036-\$0037	54-55	CSWL~CSWH	PROGRAM COUNTER FOR USER EXIT ON COUT ROUTINE (MONITOR)
\$0038-\$0039	56-57	KSWL~KSWH	PROGRAM COUNTER FOR USER EXIT ON KEYIN ROUTINE (MONITOR)
\$003A-\$003B	58-59	PCL~PCH	USER PROGRAM COUNTER SAVED HERE ON BRK TO MONITOR
\$003C	60	XGT	MONITOR MEMORY LOCATION 'XGT'
\$003C	60	XGTNZ	MONITOR MEMORY LOCATION 'XGTNZ'
\$003C-\$003D	60-61	A1L~A1H	MONITOR WORK BYTE PAIR A1
\$003E-\$003F	62-63	A2L~A2H	MONITOR WORK BYTE PAIR A2
\$0040-\$0041	64-65	A3L~A3H	MONITOR WORK BYTER PAIR A3
\$0042-\$0043	66-67	A4L~A4H	MONITOR WORK BYTE PAIR A4
\$0044	68	FMT	MINIASSEMBLER MEMORY LOCATION 'FMT'
\$0044-\$0045	68-69	A5L~A5H	MONITOR WORK BYTE PAIR A5
\$0045	69	ACC	USER AC SAVED HERE ON BRK TO MONITOR
\$0046	70	XREG	USER X-REG SAVED HERE ON BRK TO MONITOR
\$0047	71	YREG	USER Y-REG SAVED HERE ON BRK TO MONITOR
\$0048	72	STATUS	USER P STATUS SAVED HERE ON BRK TO MONITOR
\$0049	73	SPNT	USER STACK POINTER SAVED HERE ON BRK
\$004A-\$004B	74-75	LOMEML~LOMEMH	POINTER TO LOMEM
\$004C-\$004D	76-77	HIMEML~HIMEMH	POINTER TO HIMEM
\$004E-\$004F	78-79	RNDL~RNDH	16 BIT NO. RANDOMIZED WITH EACH KEY ENTRY
\$0050-\$0061	80-97		GENERAL PURPOSE POINTERS FOR APPLESOFT
\$0050-\$0051	80-81	ACL~ACH	MONITOR POINTER 'AC'
\$0050-\$0051	80-81	DXL~DXH	HIRES GRAPHICS DELTA-X FOR HLIN SHAPE
\$0051	81	SHAPEX	HIRES GRAPHICS SHAPE TEMP.
\$0052	82	DY	HIRES GRAPHICS DELTA-Y FOR HLIN SHAPE
\$0052-\$0053	82-83	XTNDL~XTNDH	MONITOR 16-BIT POINTER 'XTND'
\$0053	83	QDRNT	HI-RES GRAPHICS QDRNT: 2 LSB'S ARE ROTATION QUADRANT FOR DRAW
\$0054	84	EL	HI-RES GRAPHICS ERROR FOR HLIN
\$0054-\$0055	84-85	AUXL~AUXH	MONITOR 16-BIT POINTER 'AUX'
\$0054-\$0055	84-85	EL~EH	HI-RES GRAPHICS ERROR FOR HLIN
\$0055	85	EH	HI-RES GRAPHICS ERROR FOR HLIN
\$0062-\$0066	98-102		RESULT OF LAST MULTIPLY/DIVIDE
\$0067-\$0068	103-104	START.PROG.PTR	POINTER TO BEGINNING OF PROGRAM. NORMALLY \$0801
\$0069-\$006A	105-106	LOMEM:	POINTER TO START OF SIMPLE VARIABLE SPACE
\$006B-\$006C	107-108	ARRAY POINTER	POINTER TO BEGINNING OF ARRAY SPACE
\$006D-\$006E	109-110	FREE SPACE PNTR	POINTER TO END OF NUMERIC STORAGE IN USE
\$006F-\$0070	111-112	STRING POINTER	POINTER TO START OF STRING STORAGE. STRINGS TO END OF MEMORY

HEXLOC	DECLOC	NAME	USE
\$00B3-\$00B4	131-132		POINTER TO THE LAST-USED VARIABLE'S VALUE
\$00B5-\$009C	133-156		GENERAL USAGE
\$0095		PICK	MONITOR MEMORY LOCATION 'PICK'
\$009D-\$00A3	157-163		MAIN FLOATING-POINT ACCUMULATOR
\$00A4	164		GENERAL USE IN FLOATING POINT MATH ROUTINES
\$00A5-\$00AB	165-171		SECONDARY FLOATING POINT ACCUMULATOR
\$00AC-\$00AE	172-174		GENERAL USAGE FLAGS/POINTERS
\$00AF-\$00B0	175-176	PROGRAM POINTER	POINTER TO END OF PROGRAM. NOT CHANGED BY LOMEM.
\$00B1	177		CHRGOT S/R CALL - GETS NEXT SEQUENTIAL CHR OR TOKEN
\$00B1-\$00CB	177-200		CHRGOT ROUTINE. CALLED WHEN A-S WANTS ANOTHER CHARACTER
\$00B7	183	CHRGOT	CHRGOT S/R CALL. CHRGOT INCREMENTS TXTPTR. CHRGOT DOES NOT
\$00B8-\$00B9	184-185		PTR TO LAST CHAR OBTAINED THRU CHRGOT ROUTINE
\$00BB-\$00B9	184-185	TXTPTR	TXTPTR - POINTS AT NEXT CHAR OR TOKEN FROM PROG (C/A DEC 78)
\$00C9-\$00CD	201-205		RANDOM NUMBER
\$00CA-\$00CB	202-203	PPL~PPH	BASIC START-OF-PROGRAM POINTER
\$00CC-\$00CD	204-205	PVL~PVH	BASIC END OF VARIABLES POINTER
\$00CE-\$00CF	206-207	ACL~ACH	BASIC ACC
\$00D0-\$00DF	216-223		ONERR POINTERS/SCRATCH
\$00D0	216		POKE 0 TO CLEAR ERROR FLAG
\$00DE	222		WHEN ERROR OCCURS~ ERROR CODE APPEARS HERE
\$00E0-\$00E2	224-226		HI-RES GRAPHICS X&Y COORDINATES
\$00E4	228		HI-RES GRAPHICS COLOR BYTE
\$00E5-\$00E7	229-231		GENERAL USAGE FOR HI-RES GRAPHICS
\$00E8-\$00E9	232-233		POINTER TO BEGINNING OF SHAPE TABLE
\$00EA	234		COLLISION COUNTER FOR HI-RES GRAPHICS
\$00F0-\$00F3	240-243		GENERAL USE FLAGS
\$00F3		SIGN	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'SIGN'
\$00F4	244	X2	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'X2' (EXPONENT 2)
\$00F4-\$00F8	244-248		ONERR POINTERS
\$00F5	245	M2	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'M2' (MANTISSA 2)
\$00F7	247	S16PAQ	SWEET-16 MEMORY LOCATION 'S16PAQ'
\$00F8	248	X1	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'X1' (EXPONENT 1)
\$00F9	249	M1	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'M1' (MANTISSA 1)
\$00FC	252	E	MONITOR & FLOATING POINT ROUTINES MEMORY LOC 'E'
\$0100-\$01FF	256-511		SUBROUTINE RETURN STACK
\$0200	512	IN	MONITOR & MINIASSEMBLER MEMORY LOCATION 'IN'
\$0200-\$02FF	512-767		KEYIN (INPUT) BUFFER
\$0300-\$03FF	768-1023		AREA Clobbered BY EITHER MASTER OR SLAVE DISKETTE BOOT
\$0300-\$03F7	768-1015		OFTEN FREE SPACE. NOTE COMPETING USES OFTEN FREE SPACE CONSTRAINTS
\$0300. \$03AF	768-943		DECRITER PRINTER OUTPUT (IF BLOADED FROM DISK)
\$0320-\$0321	800-801	XOL~XOH	HI-RES GRAPHICS- PRIOR X-COORD SAVE AFTER HLIN OR HPLLOT
\$0322	802	YO	HI-RES GRAPHICS YO - MOST RECENT Y-COORDINATE
\$0323	803	BXSAV	HI-RES GRAPHICS 'BXSAV'
\$0324	804	HCOLOR	HI-RES GRAPHICS COLOR FOR HPLLOT~ HPOSN
\$0325	805	HNDX	HI-RES GRAPHICS HNDX - ON-THE-FLY BYTE INDEX FROM BASE ADDRESS
\$0326	806	HPAG	POKE 32 FOR HI-RES PG1 PLOTTING~ 64 FOR PAGE2
\$0326	806	HPAG	HI-RES GRAPHICS MEM PAGE FOR PLOTTING GRAPHICS \$20 FOR PG1 ~\$40 FOR PG2
\$0327	807	SCALE	ON-THE-FLY SCALE FACTOR FOR DRAW~ SHAPE~ MOVE
\$0328-\$0329	808-809	SHAPXL~SHAPXH	START-OF-SHAPE-TABLE POINTER
\$032A	810	COLLSN	COLLISION COUNT FROM DRAW~DRAW1
\$03D0	976		DOS RE-ENTRY POINT (3DOG)
\$03D0	976		INITIALIZE OR RE-INITIALIZE DOS (3DOG)
\$03D3	979		DOS 3.1 HARD ENTRY POINT
\$03D6	982		DOS 3.1 ENTRY POINT FOR I/O PACKAGE
\$03D9	985		DOS 3.1 ENTRY POINT FOR RWTS
\$03DC	988		DOS 3.1 ENTRY POINT TO LOAD Y~A WITH ADDRESS AT END OF SYS BUFFER
\$03E3	995	995	DOS 3.1 ENTRY POINT TO LOAD Y~A WITH ADDRESS OF IOBLK
\$03EA	1002	1002	DOS 3.2 ENTRY POINT FOR ROUTINE THAT UPDATES I/O HOOK TABLES
\$03FB	1016	USRADR	CTL-Y WILL CAUSE JSR HERE
\$03FB	1019	NMI	NMI'S VECTORED TO THIS LOCATION
\$03FE	1022	IRGADR	MONITOR MEMORY LOCATION 'IRGADR'
\$03FE-\$03FF	1022-1023		IRQ'S VECTORED TO ADDRESS WHOSE POINTER IS HERE
\$0400-\$07FF	1024-2043		SCREEN BUFFER (HARDWARE PAGES 4-7)(LOW-RES GRAPHICS & TEXT PAGE 1)
\$047B+S	1144+S	BRATE	SERIAL INTERFACE BAUD QUANTUM RATE. \$1= 19200 BAUD;\$40=300 BAUD
\$047B+S	1144+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$04FB+S	1272+S	STBITS	SERIAL INTERFACE: CONTAIN NUMBER OF STOP BITS (INCLUDING 1 PARITY BIT)
\$04FB+S	1272+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$057B+S	1400+S	STATUS	SERIAL INTERFACE: PARITY CHECKSUM OPTIONS (SEE MANUAL)
\$057B+S	1400+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT#S
\$05FB+S	1528+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$067B+S	1656+S	BYTE	SERIAL INTERFACE INPUT OUTPUT BUFFER
\$067B+S	1656+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$06FB	1784+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$06FB+S	1784+S	PWDTH	SERIAL INTERFACE PRINT LINE WIDTH (# CHARS PER LINE)
\$077B+S	1912+S	NBITS	SERIAL INTERFACE NUMBER OF DATA BITS PLUS 1 FOR START BIT
\$077B+S	1912+S		SCRATCHPAD MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$07FB+S	2040+S	FLAGS	SERIAL INTERFACE OPERATION MODE
\$07FB+S	2040+S		INTERRUPT RETURN MEMORY BYTE FOR PERIPHERAL IN SLOT #S
\$0800	2048		DEFAULT INTEGER BASIC LOMEM
\$0800-\$09FF	2048-2559		AREA Clobbered BY EITHER MASTER OR SLAVE DISKETTE BOOT
\$0800-\$0BFF	2048-3071		SECONDARY SCREEN BUFFER (TEXT & LOW-RES GRAPHICS PAGE 2)

HEXL0C	DECLOC	NAME	USE
\$0800-\$C000	2048-49152		RANGE OF POSSIBLE SETTINGS FOR HIMEM (DEPENDING UPON MEM SIZE~ DOS
\$0800-L0MEM	2048-L0MEM		PROGRAM STORAGE FOR ROM VERSION OF APPLESOFT
\$0C00	3072		DEFAULT LOCATION FOR START OF SHAPE TABLE AS SET BY HI-RES SHAPE LOAD
\$0C00-\$1FFF	3072-8191		OFTEN FREE SPACE
\$0CF2	3314		TO CNVRT A/S PROG FM ROM TO CASSETTE: LOAD PROG~ CALL 3314~LIST~SAVE
\$1B00-\$3FFF	4000-16383		THIS REGION OF MEMORY IS CLOBBED BY A SLAVE DISKETTE BOOT
\$1B00-\$4000	6912-16384		RAWDOS (VERSION OF DOS USED WITH MASTER.CREATE - FROM DISK)
\$2000-\$3FFF	8192-16383		HI-RES GRAPHICS PAGE 1
\$3000-L0MEM	12288-L0MEM		PROGRAM STORAGE FOR RAM VERSION OF APPLESOFT
\$3F3-\$3F4	1011-1012		DOS 3.1 - POKE TO ZEROS TO REBOOT HELLO PROGRAM
\$4000-\$4520	16384-17696		NORMAL LOCATION FOR KAPOR'S HI RES TEXT SET
\$4000-\$5FFF	16384-24575		HI-RES GRAPHICS PAGE 2
\$4300	17664		CALL FOR INVERSION BY KAPOR'S ROUTINE
\$4500-4520	17664-17696		S/R W/ KAPOR'S HI-RES TEXT SET TO INVERT WHITE TO BLACK & VICEVERSA
\$5600-\$8000	22016-32768		DISK OPERATING SYSTEM (DOS3.1)
\$9600-\$9853	-27136--26541		DOS 3.1 USER BUFFER #1
\$9600-\$9700	-27136--26880		DOS 3.1 USER BUFFER #1 DATA BUFFER
\$9701-\$9802	-26879--26622		DOS 3.1 USER BUFFER #1 - LIST OF SECTOR & TRACK NUMBERS USED
\$9801-\$9853	-26623--26541		DOS 3.1 USER BUFFER #1 - FILE NAME & MISC DATA
\$9D10-?	-25328-?		STARTING ADDRESSES FOR VARIOUS DOS3.1 TASKS
\$9D73-\$A7DF	-25229--25561		SYSTEM SECTION OF DOS 3.1
\$9DB9	-29159		INITIALIZE OR RE-INITIALIZE DOS
\$9E4D	-25011		ROUTINE WHICH HANDLES DOS INPUT HOOK
\$9E7E	-24962		ROUTINE WHICH HANDLES DOS OUTPUT HOOK
\$A1B4	-24140		ADDRESS FOR DOS3.1 PR# COMMAND
\$A1B9	-24135		ADDRESS FOR DOS 3.1 IN# COMMAND
\$A1BE	-24130		ADDRESS FOR DOS 3.1 MON COMMAND
\$A1DC	-24100		ADDRESS FOR DOS 3.1 MAXFILES COMMAND
\$A1EE	-24082		ADDRESS FOR DOS 3.1 DELETE COMMAND
\$A1FC	-24068		ADDRESS FOR DOS 3.1 LOCK COMMAND
\$A200	-24064		ADDRESS FOR DOS 3.1 BSAVE COMMAND
\$A200	-24064		ADDRESS FOR DOS 3.1 UNLOCK COMMAND
\$A208	-24056		ADDRESS FOR DOS 3.1 VERIFY COMMAND
\$A20C	-24052		ADDRESS FOR DOS 3.1 RENAME COMMAND
\$A223	-24029		ADDRESS FOR DOS 3.1 APPEND COMMAND
\$A236	-24010		ADDRESS FOR DOS 3.1 OPEN COMMAND
\$A278	-23944		ADDRESS FOR DOS 3.1 CLOSE COMMAND
\$A2EC	-23828		ADDRESS FOR DOS 3.1 BLOAD COMMAND
\$A327	-23769		ADDRESS FOR DOS 3.1 BRUN COMMAND
\$A330	-23760		ADDRESS FOR DOS 3.1 SAVE COMMAND
\$A3A5	-23643		ADDRESS FOR DOS 3.1 LOAD COMMAND
\$A476	-23434		ADDRESS FOR DOS 3.1 RUN COMMAND
\$A48D	-23411		ADDRESS FOR DOS 3.1 CHAIN COMMAND
\$A4A5	-23387		ADDRESS FOR DOS3.1 WRITE COMMAND
\$A480	-23376		ADDRESS FOR DOS 3.1 READ COMMAND
\$A4E4	-23324		ADDRESS FOR DOS 3.1 INIT COMMAND
\$A501	-23295		ADDRESS FOR DOS 3.1 NOMON COMMAND
\$A50D	-23283		ADDRESS FOR DOS 3.1 FP COMMAND
\$A531	-23247		ADDRESS FOR DOS 3.1 INT COMMAND
\$A54F	-23217		ADDRESS FOR DOS 3.1 EXEC COMMAND
\$A566	-23210		ADDRESS FOR DOS 3.1 POSITION COMMAND
\$A7E0-\$AB63	-22560--22439		DOS COMMAND TABLE
\$ABCD-\$A980	-22323--22144		DOS ERROR MSG TABLE
\$A996-\$A997	-22122--22121		DOS INTERNAL HOOK ADDRESS TO OUTPUT A CHARACTER
\$A998-\$A999	-22120--22119		DOS INTERNAL HOOK ADDRESS TO INPUT A CHARACTER
\$A9A3-\$A9A4	-22109--22108		LENGTH OF BLOADED FILE
\$A9B5-\$A9B6	-22091--22090		STARTING ADDRESS OF BLOADED FILE
\$AA0B	-22005		START OF LIST OF POINTERS TO SECTIONS OF DOS 3.1 I/O PACKAGES
\$AA3F-\$B2CE	-21953--19762		DOS 3.1 I/O PACKAGE
\$B3EF-\$B642	-19473--18878		DOS 3.1 SYSTEM BUFFER (FOR CATALOG ETC.)
\$BD00	-17152		ROUTINE WHICH READS IN DIRECTORY OFF DISK
\$BF6			VOL NO OF CURRENT DISK
\$BFFF	-16384		HIGHEST RAM MEMORY ADDRESS
\$BFFF	-16384		DEFAULT INTEGER BASIC HIMEM (W/O DOS~ 48K MACHINE)
\$C000	-16384	KBD ~ IOADR	READ KEYBOARD. IF VAL>127 THEN KEY WAS PRESSED
\$C000-\$C00F	-16384--16369		KEYBOARD INPUT SUBROUTINE
\$C000-\$CFFF	-16384--12289		ADDRESSES DEDICATED TO HARDWARE FUNCTION
\$C010	-16368	KBDSTB	CLEAR KEYBOARD STROBE. POKE 0 ALWAYS AFTER READING KBD.
\$C010-\$C01F	-16368--16353		CLEAR KEYBOARD STROBE SUBROUTINE
\$C020	-16352	TAPEOUT	MONITOR MEMORY LOCATION 'TAPEOUT'
\$C02X	-16352		TOGGLE CASSETTE OUTPUT
\$C030	-16336	SPKR	PEEK TO TOGGLE SPEAKER
\$C04X	-16320		OUTPUT STROBE TO GAME I/O CONNECTOR
\$C050	-16304	TXTCLE	POKE TO 0 TO SET GRAPHICS MODE
\$C051	-16303	TXTSET	POKE 0 TO SET TEXT MODE
\$C052	-16302	MIXCLR	POKE 0 TO SET BOTTOM 4 LINES TO GRAPHICS
\$C053	-16301	MIXSET	POKE=0 TO SELECT TEXT/GRAPHICS MIX (BOTTOM 4 LINES TEXT)
\$C054	-16300	LOWSCR	POKE TO 0 TO DISPLAY PRIMARY PAGE (PAGE 1)
\$C055	-16299	HISCR	POKE TO 0 TO DISPLAY SECONDARY PAGE (PAGE2)
\$C056	-16298	LORES	POKE TO 0 TO SET LO-RES GRAPHICS
\$C057	-16297	HIRES	POKE TO 0 TO SET HI-RES GRAPHICS

HEXLOC	DECLOC	NAME	USE
\$C058	-16296		POKE 0 TO CLEAR GAME I/O OUTPUT AN0
\$C059	-16295		POKE 0 TO SET GAME I/O OUTPUT AN0
\$C05A	-16294		POKE 0 TO CLEAR GAME I/O OUTPUT AN1
\$C05B	-16293		POKE 0 TO SET GAME I/O OUTPUT AN1
\$C05C	-16292		POKE 0 TO CLEAR GAME I/O OUTPUT AN2
\$C05D	-16291		POKE 0 TO SET GAME I/O OUTPUT AN2
\$C05E	-16290		POKE 0 TO CLEAR GAME I/O OUTPUT AN3
\$C05F	-16289		POKE 0 TO SET GAME I/O OUTPUT AN3
\$C060	-16288	TAPEIN	MONITOR MEMORY LOCATION 'TAPEIN'
\$C060/B	-16288		STATE OF 'CASSETTE DATA IN' APPEARS IN BIT 7
\$C061	-16287		PEEK TO READ PDL(0). IF >127 SWITCH ON
\$C062	-16286		PEEK TO READ PDL(1) PUSH BUTTON SWITCH
\$C063	-16285		PEEK TO READ PDL(2) PUSH BUTTON SWITCH
\$C064	-16188	PADDLO	MONITOR MEMORY LOCATION PADDLO
\$C064/C	-16188		STATE OF TIMER OUTPUT FOR PADDLE 1 APPEARS IN BIT 7
\$C065/D	-16187		STATE OF TIMER OUTPUT FOR PADDLE 1 APPEARS IN BIT 7
\$C066/E	-16186		STATE OF TIMER OUTPUT FOR PADDLE 2 APPEARS IN BIT 7
\$C067/F	-16185		STATE OF TIMER OUTPUT FOR PADDLE 3 APPEARS IN BIT 7
\$C070	-16272	PTRIG	MONITOR MEMORY LOCATION 'PTRIG' (PADDLE TRIGGER)
\$C07X	-16272	PTRIG	TRIGGERS PADDLE TIMERS DURING PHI-2
\$C08X	-16256		DEVICE SELECT 0
\$C09X	-16240		DEVICE SELECT 1
\$C0AX	-16224	DEVICE SELECT 2	DEVICE SELECT 2
\$C0BX	-16208		DEVICE SELECT 3
\$C0CX	-16192		DEVICE SELECT 4
\$C0DX	-16176		DEVICE SELECT 5
\$C0EB	-16152		ADDRESS TO POWER DOWN DISK IN SLOT 6
\$C0E9	-16151		ADDRESS TO POWER UP DISK IN SLOT 6
\$C0EX	-16160		DEVICE SELECT 6
\$C0FX	-16144		DEVICE SELECT 7
\$C100	-16128		CALL -16128 IS EQUIVALENT TO PR#1 FOR INITIALIZING SERIAL INTERFACE
\$C100	-16128		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #1
\$C200	-15842		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #2
\$C300	-15616		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #3
\$C400	-15360		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #4
\$C500	-15104		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #5
\$C600	-14848		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #6
\$C700	-14592		STANDARD CHARACTER I/O SUBROUTINE ENTRY POINT FOR SLOT #6
\$C800-\$CFFF	-14336--12289		PIN 20 ON ALL PERIPH CONCTRS GOES LOW DURING PHI0 ON READ OR WRITE
\$C93D	-14109		SERIAL INTERFACE BATCH INPUT ROUTINE. A1&A2 SPECIFY MEMORY RANGE
\$C941	-14105		SERIAL INTERFACE BATCH OUTPUT ROUTINE - A1 & A2 SPECIFY MEMORY RANGE
\$C500	-16384+236*S		TRANSMIT ASCII CHAR IN ACCUMULATOR OUT VIA SERIAL INTERFACE IN SLOT 5
\$D000	-12288	SETHRL	HI-RES GRAPHICS INIT S/R CALL (ROM VERSION)
\$D000-\$D3FF	-12288--11265		HI-RES GRAPHICS ROM
\$D000-\$D7FF	-12288--10241		ROM SOCKET D0
\$D00E	-12274	HCLR	HI-RES GRAPHICS CLEAR S/R CALL
\$D010	-12272	BKGND0	HI-RES GRAPHICS 'BKGND0' (HCOLOR1 SET FOR BLACK BKGND)
\$D012	-12270	BKGND	HI-RES GRAPHICS MEMORY LOCATION 'BKGND' (ROM)
\$D1FC	-11780		HI-RES GRAPHICS FIND S/R CALL: PARAM=SHAPE~ROT~SCALE
\$D2F9	-11527		HI-RES GRAPHICS POSN S/R CALL PARAM= X0~Y0~COLR
\$D30E	-11506		HI-RES GRAPHICS PLOT S/R CALL PARAM= X0~Y0~COLR
\$D314	-11500		HI-RES GRAPHICS LINE S/R CALL PARAM= X0~Y0~COLR
\$D331	-11471		HI-RES GRAPHICS BKGND S/R CALL PARAM= COLR
\$D337	-11465		HI-RES GRAPHICS LINE S/R CALL: PARAM=X0~Y0~COLR
\$D33A	-11462		HI-RES GRAPHICS DRAW1 S/R CALL: PARAM= X0~Y0~COLR~SHAPE~ROT~SCALE
\$D3B9	-11335		HI-RES GRAPHICS SHLOAD S/R CALL
\$D48C	-11076		INTEGER BASIC PA#1 APPEND PROGRAM ENTRY
\$D4F2	-11022		TO CONVERT A/S FM CASSETTE TO ROM- LD FM CASS~CALL -11022~LIST~SAVE
\$D535	-10955		INTEGER BASIC PA#1 TAPE VERIFY PROG ENTRY
\$D6DD	-10531		INTEGER BASIC PA#1 RENUMBER PROG ENTRY (WHOLE PROG)
\$D6E7	-10521		INTEGER BASIC PA#1 RENUMBER PROG ENTRY (PART PROG)
\$D717	-10473		INTEGER BASIC PA#1 MUSIC PROG ENTRY
\$D800-\$DFFF	-10240--8193		ROM SOCKET D8
\$DD67	-8867		FRMNUM S/R. EVALS FORMULA EXP. INTO FLOATING PT ACCUM
\$DEC9	-8503		SNERR S/R. PRINTS "SYNTAX ERROR" AND HALTS PROG
\$E000	-8192	BASIC	ENTER INTEGER BASIC
\$E000-\$E7FF	-8192--6145		ROM SOCKET E0 (INTEGER BASIC)
\$E003	-8189	BASIC2	ENTRY 2 OF INTEGER BASIC
\$E36B	-7317	MEMFUL	INTEGER BASIC MEMORY FULL ERROR
\$E51B	-6885		INTEGER BASIC DECIMAL LPRINT S/R
\$E6F8	-6408		GETBYT S/R. EVALS FORMULA & CONVTS TO 1-BYT VAL IN X REG
\$E800-\$EFFF	-6144--4097		ROM SOCKET EB (INTEGER BASIC)
\$EE68	-4504	RNGERR	INTEGER BASIC RANGE ERROR
\$F000-\$F7FF	-4096--2049		ROM SOCKET FO (1K INTEGER BASIC~ 1 K MONITOR)
\$F11E	-3810	ACADR	HI-RES GRAPHICS 2-BYTE TAPE READ SETUP
\$F666	-2458		TURN ON MINIASSEMBLER
\$F689	-2423		SWEET-16 INTERPRETER ENTRY
\$F800	-2048	PLOT	MONITOR S/R PLOT A POINT (LO-RES) AC:Y-COORD Y:X-COORD
\$F800	-2048	PLOT	MONITOR S/R PLOT A POINT. AC:Y-COORD~Y:X-COORD
\$F800-\$FFFF	-2048--1		ROM SOCKET F8 (MONITOR)

HEXLOC	DECLOC	NAME	USE
\$F80C	-2036	RTMASK	MONITOR MEMORY LOCATION 'RTMASK'
\$F80E	-2034	PLOT1	MONITOR MEMORY LOCATION 'PLOT1'
\$F819	-2023	HLINE	HLINE S/R (SEE CALL-APPLE NOV/DEC 78 PG4)
\$F819	-2023	HLINE	MONITOR S/R TO DRAW A HORIZONTAL LINE (LO-RES)
\$F81C	-2020	HLINE1	MONITOR MEMORY LOCATION 'HLINE1'
\$F826	-2010	VLINEZ	MONITOR MEMORY LOCATION 'VLINEZ'
\$F828	-2008	VLINE	DRAW A VERTICAL LINE
\$F831	-1999	RTS1	MONITOR MEMORY LOCATION 'RTS1'
\$F832	-1998	CLRSCR	CLEAR SCREEN - GRAPHICS MODE
\$F832	-1998	CLRSCR	CLEAR LOW RES GRAPHICS SCREEN1
\$F836	-1994	CLRTOP	MONITOR MEMORY LOCATION 'CLRTOP'
\$F838	-1992	CLRSC2	MONITOR MEMORY LOCATION 'CLRSC2'
\$F83C	-1988	CLRSC3	MONITOR MEMORY LOCATION 'CLRSC3'
\$F847	-1977	GBASCALC	MONITOR S/R TO CALCULATE GRAPHICS BASE ADDRESS
\$F856	-1962	GBCALC	MONITOR MEMORY LOCATION 'GBCALC'
\$F85F	-1953	NXTCOL	MONITOR S/R - INCREMENT COLOR BY 3
\$F864	-1948	SETCOL	MONITOR S/R TO ADJUST COLOR BYTE FOR BOTH HALVES EQUAL
\$F871	-1935	SCRN	SCRN S/R (LO-RES GRAPHICS) (SEE CALL-APPLE DEC78)
\$F871	-1935	SCRN	MONITOR S/R TO GET SCREEN COLOR. AC:Y-COORD~Y: X-COORD
\$F879	-1927	SCRN2	MONITOR MEMORY LOCATION 'SCRN2'
\$F87F	-1921	RTMSKZ	MONITOR MEMORY LOCATION 'RTMSKZ'
\$F882	-1918	INSDS1	MONITOR MEMORY LOCATION 'INSDS1'
\$F88E	-1906	INSDS2	MONITOR S/R - DISASSEMBLER ENTRY
\$F89B	-1893	IEVEN	MONITOR MEMORY LOCATION 'IEVEN'
\$F8A5	-1883	ERR	MONITOR MEMORY LOCATION 'ERR'
\$F8A9	-1879	GETFMT	MONITOR MEMORY LOCATION GETFMT
\$F8BE	-1858	MNNDX1	MONITOR MEMORY LOCATION 'MNNDX1'
\$F8C2	-1854	MNNDX2	MONITOR MEMORY LOCATION 'MNNDX2'
\$F8C9	-1847	MNNDX3	MONITOR MEMORY LOCATION 'MNNDX3'
\$F8D0	-1840	INSTDSP	MONITOR & MINIASSEMBLER MEMORY LOCATION 'INSTDSP'
\$F8D4	-1836	PRNTOP	MONITOR MEMORY LOCATION 'PRNTOP'
\$F8DB	-1829	PRNTBL	MONITOR MEMORY LOCATION 'PRNTBL'
\$F8F5	-1803	PRMN1	MONITOR MEMORY LOCATION 'PRMN1'
\$F8F9	-1799	PRMN2	MONITOR MEMORY LOCATION 'PRMN2'
\$F910	-1776	PRADR1	MONITOR MEMORY LOCATION 'PRADR1'
\$F914	-1772	PRADR2	MONITOR MEMORY LOCATION 'PRADR2'
\$F926	-1754	PRADR3	MONITOR MEMORY LOCATION 'PRADR3'
\$F92A	-1750	PRADR4	MONITOR MEMORY LOCATION 'PRADR4'
\$F930	-1744	PRADR5	MONITOR MEMORY LOCATION 'PRADR5'
\$F938	-1736	RELADR	MONITOR MEMORY LOCATION 'RELADR'
\$F940	-1728	PRNTYX	MONITOR S/R- PRINT CONTENTS OF Y AND X AS 4 HEX DIGITS
\$F941	-1727	PRNTAX	MONITOR MEMORY LOCATION 'PRNTAX'
\$F944	-1724	PRNTX	MONITOR MEMORY LOCATION 'PRNTX'
\$F948	-1720	PRBLNK	MONITOR MEMORY LOCATION 'PRBLNK'
\$F94C	-1716	PRBL2	MONITOR S/R- PRINT BLANKS: X REG CONTAINS NUMBER TO PRINT.
\$F94C	-1716	PRBL3	MONITOR MEMORY LOCATION 'PRBL3'
\$F953	-1709	PCADJ	MINIASSEMBLER MEMORY LOCATION 'PCADJ'
\$F954	-1708	PCADJ2	MONITOR & MINIASSEMBLER MEMORY LOCATION 'PCADJ2'
\$F956	-1706	PCADJ4	MONITOR MEMORY LOCATION 'PCADJ4'
\$F961	-1693	RTS2	MONITOR MEMORY LOCATION 'RTS2'
\$F962	-1694	FMT1	MONITOR MEMORY LOCATION 'FMT1'
\$F9A6	-1626	FMT2	MONITOR MEMORY LOCATION 'FMT2'
\$F9B4	-1612	CHAR1	MONITOR & MINIASSEMBLER MEMORY LOCATION 'CHAR1'
\$F9BA	-1606	CHAR2	MONITOR & MINIASSEMBLER MEMORY LOCATION 'CHAR2'
\$F9C0	-1600	MNEML	MONITOR & MINIASSEMBLER MEMORY LOCATION 'MNEML'
\$FA00	-1536	MNEMR	MONITOR & MINIASSEMBLER MEMORY LOCATION 'MNEMR'
\$FA43	-1469	STEP	MONITOR S/R- PERFORM A SINGLE STEP
\$FA4E	-1458	XGINIT	MONITOR MEMORY LOCATION 'XGINIT'
\$FA78	-1416	XG1	MONITOR MEMORY LOCATION 'XG1'
\$FA7A	-1414	XG2	MONITOR MEMORY LOCATION 'XG2'
\$FAB6	-1402	IRQ	MONITOR S/R- IRQ HANDLER
\$FA92	-1390	BREAK	MONITOR S/R - BREAK HANDLER
\$FA9C	-1380	XBRK	MONITOR MEMORY LOCATION 'XBRK'
\$FAA5	-1371	XRT1	MONITOR MEMORY LOCATION 'XRT1'
\$FAA9	-1367	XRTS	MONITOR MEMORY LOCATION 'XRTS'
\$FAAD	-1363	PCINC2	MONITOR MEMORY LOCATION 'PCINC2'
\$FAAF	-1361	PCINC3	MONITOR MEMORY LOCATION 'PCINC3'
\$FAB9	-1351	XJSR	MONITOR MEMORY LOCATION 'XJSR'
\$FAC4	-1340	XJMP	MONITOR MEMORY LOCATION 'XJMP'
\$FAC5	-1339	XJMPAT	MONITOR MEMORY LOCATION 'XJMPAT'
\$FACD	-1331	NEWPCL	MONITOR MEMORY LOCATION 'NEWPCL'
\$FAD1	-1327	RTNJMP	MONITOR MEMORY LOCATION 'RTNJMP'
\$FAD7	-1321	REGDSP	MONITOR S/R TO DISPLAY USER REGISTERS
\$FADA	-1318	RGDSP1	MONITOR MEMORY LOCATION 'RGDSP1'
\$FAE4	-1308	RDSP1	MONITOR MEMORY LOCATION 'RDSP1'
\$FAFD	-1283	BRANCH	MONITOR MEMORY LOCATION 'BRANCH'
\$FBOB	-1269	NBRNCH	MONITOR MEMORY LOCATION 'NBRNCH'
\$FB11	-1263	INITBL	MONITOR MEMORY LOCATION 'INITBL'
\$FB19	-1255	RTBL	MONITOR MEMORY LOCATION 'RTBL'
\$FB1E	-1250	PREAD	MONITOR S/R TO READ PADDLE. X-REG CONTAINS PADDLE NUMBER 0-3
\$FB25	-1243	PREAD2	MONITOR MEMORY LOCATION 'PREAD2'

HEXLOC	DECLOC	NAME	USE
\$FB2E	-1234	RTS2D	MONITOR MEMORY LOCATION 'RTS2D'
\$FB2F	-1233	INIT	MONITOR S/R- SCREEN INITIALIZATION
\$FB39	-1223	SETTXT	MONITOR S/R- SET SCREEN TO TEXT MODE. CLOBBERS ACCUMULATOR
\$FB40	-1216	SETGR	MONITOR S/R- SET GRAPHIC MODE (GR). CLOBBERS ACCUMULATOR
\$FB4B	-1205	SETWND	MONITOR S/R- SET NORMAL WINDOW
\$FB5B	-1189	TABV	MONITOR MEMORY LOCATION 'TABV'
\$FB60	-1184	MULPM	MONITOR MEMORY LOCATION 'MULPM'
\$FB63	-1181	MUL	MONITOR S/R- MULTIPLY ROUTINE
\$FB65	-1179	MUL2	MONITOR MEMORY LOCATION 'MUL2'
\$FB6D	-1171	MUL3	MONITOR MEMORY LOCATION 'MUL3'
\$FB76	-1162	MUL4	MONITOR MEMORY LOCATION 'MUL4'
\$FB78	-1160	MUL5	MONITOR MEMORY LOCATION 'MUL5'
\$FB81	-1151	DIVPM	MONITOR MEMORY LOCATION 'DIVPM'
\$FB84	-1148	DIV	MONITOR S/R- DIVIDE ROUTINE
\$FB86	-1146	DIV2	MONITOR MEMORY LOCATION 'DIV2'
\$FBA0	-1120	DIV3	MONITOR MEMORY LOCATION 'DIV3'
\$FBA4	-1116	MD1	MONITOR MEMORY LOCATION 'MD1'
\$FBAF	-1105	MD2	MONITOR MEMORY LOCATION 'MD2'
\$FBB4	-1100	MD3	MONITOR MEMORY LOCATION 'MD3'
\$FBC0	-1088	MDRTS	MONITOR MEMORY LOCATION 'MDRTS'
\$FBC1	-1087	BASCALC	MONITOR S/R- CALCULATE TEXT BASE ADDRESS
\$FBD0	-1072	BSCLC2	MONITOR MEMORY LOCATION 'BSCLC2'
\$FBD9	-1063	BELL1	MONITOR MEMORY LOCATION 'BELL1'
\$FBE4	-1052	BELL2	MONITOR S/R- SOUND BELL (BEEPER)
\$FBEF	-1041	RTS2B	MONITOR MEMORY LOCATION 'RTS2B'
\$FBF0	-1040	STOADV	MONITOR MEMORY LOCATION 'STOADV'
\$FBF4	-1036	ADVANCE	MONITOR S/R- MOVE CURSOR RIGHT
\$FBFC	-1028	RTS3	MONITOR MEMORY LOCATION 'RTS3'
\$FBFD	-1027	VIDOUT	MONITOR S/R- OUTPUT A-REGISTER AS ASCII ON TEXT SCREEN 1
\$FC10	-1008	BS	MONITOR S/R TO MOVE CURSOR LEFT (BACKSPACE)
\$FC1A	-998	UP ~ CURSUP	MONITOR S/R TO CURSOR UP
\$FC22	-990	VTAB	MONITOR S/R- PERFORM A VERTICAL TAB TO ROW SPECIFIED IN ACCUM (\$0-\$17)
\$FC24	-988	VTABZ	MONITOR MEMORY LOCATION 'VTABZ'
\$FC2B	-981	RTS4	MONITOR MEMORY LOCATION 'RTS4'
\$FC2C	-980	ESC1	MONITOR S/R- PERFORM ESCAPE FUNCTIONS
\$FC42	-958	CLREOP	MONITOR S/R TO CLEAR FROM CURSOR TO END OF PAGE. CLOBBERS ACC & Y-REG
\$FC46	-954	CLEOP1	MONITOR MEMORY LOCATION 'CLEOP1'
\$FC58	-936	HOME	MONITOR S/R TO HOME CURSOR & CLEAR SCREEN. CLOBBERS ACCUM & Y-REG
\$FC62	-926	CR	MONITOR S/R TO PERFORM A CARRIAGE RETURN
\$FC66	-922	LF	MONITOR S/R TO TO PERFORM A LINE FEED
\$FC70	-912	SCROLL	MONITOR S/R TO SCROLL UP 1 LINE. CLOBBERS ACCUM & Y-REG
\$FC76	-906	SCRL1	MONITOR MEMORY LOCATION 'SCRL1'
\$FC8C	-884	SCRL2	MONITOR MEMORY LOCATION 'SCRL2'
\$FC95	-875	SCRL3	MONITOR MEMORY LOCATION 'SCRL3'
\$FC9C	-868	CLREOL	MONITOR S/R TO CLEAR TO END OF LINE
\$FC9E	-866	CLEOLZ	MONITOR MEMORY LOCATION 'CLEOLZ'
\$FCA0	-864	CLEOL2	MONITOR MEMORY LOCATION 'CLEOL2'
\$FCA8	-856	WAIT	CALL FOR WAIT LOOP
\$FCA9	-855	WAIT2	MONITOR MEMORY LOCATION 'WAIT2'
\$FCAA	-854	WAIT3	MONITOR MEMORY LOCATION 'WAIT3'
\$FCB4	-844	NXTA4	MONITOR S/R TO INCREMENT A4 (16 BITS) THEN DO NXTA1
\$FCBA	-838	NXTA1	MONITOR S/R TO INCREMENT A1 (16 BITS). SETT CARRY IF RESULT >=A2.
\$FCCB	-824	RTS4B	MONITOR MEMORY LOCATION 'RTS4B'
\$FCC9	-823	HEADR	MONITOR MEMORY LOCATION 'HEADR'
\$FCD6	-810	WRBIT	MONITOR MEMORY LOCATION 'WRBIT'
\$FCDB	-805	ZERDLY	MONITOR MEMORY LOCATION 'ZERDLY'
\$FCE2	-798	ONEDLY	MONITOR MEMORY LOCATION 'ONEDLY'
\$FCE5	-795	WRTAPE	MONITOR MEMORY LOCATION 'WRTAPE'
\$FCEC	-798	RDBYTE	MONITOR MEMORY LOCATION 'RDBYTE'
\$FCEE	-786	RDBYT2	MONITOR MEMORY LOCATION 'RDBYT2'
\$FCFA	-774	RD2BIT	MONITOR TWO-EDGE TAPE SENSE
\$FCFD	-771	RDBIT	MONITOR MEMORY LOCATION 'RDBIT'
\$FDOC	-756	RDKEY	GET KEY INPUT FROM THE KEYBOARD. CLOBBERS ACC ~ Y-REG
\$FD18	-741	KEYIN	MONITOR S/R- MONITOR KEYIN ROUTINE
\$FD21	-735	KEYIN2	MONITOR MEMORY LOCATION 'KEYIN2'
\$FD2F	-721	ESC	MONITOR MEMORY LOCATION 'ESC'
\$FD35	-715	RDCHAR	CALL TO READ KEY & PERFORM ESCAPE FUNCTION IF NECESSARY.
\$FD3D	-707	NOTCR	MONITOR MEMORY LOCATION 'NOTCR'
\$FD5F	-673	NOTCR1	MONITOR MEMORY LOCATION 'NOTCR1'
\$FD62	-670	CANCEL	MONITOR S/R TO PERFORM A LINE CANCEL (\)
\$FD67	-665	GETLNZ	MONITOR S/R TO PERFORM CARRIAGE RETURN AND GET A LINE OF TEXT
\$FD6A	-662	GETLN	MONITOR S/R TO GET LINE OF TEXT FROM KEYBD. X RETND W/ # OF CHARS
\$FD71	-655	BCKSPC	MONITOR MEMORY LOCATION 'BCKSPC'
\$FD75	-651	NXTCHAR	MONITOR MEMORY LOCATION 'NXTCHAR'
\$FD7E	-642	CAPTST	MONITOR MEMORY LOCATION 'CAPTST'
\$FD80	-640	INSTDSP	MONITOR S/R TO DISASSEMBLE INSTRUCTION AT PCH/PCL
\$FD84	-636	ADDINP	MONITOR MEMORY LOCATION 'ADDINP'
\$FD8E	-626	CROUT	MONITOR S/R TO PRINT A CARRIAGE RETURN. CLOBBERS ACC~ Y-REG
\$FD92	-622	PRA1	MONITOR MEMORY LOCATION 'PRA1'
\$FD96	-618	PRYX2	MONITOR MEMORY LOCATION 'PRYX2'

HEXL0C	DECLOC	NAME	USE
\$FDA3	-605	XAMB	MONITOR MEMORY LOCATION 'XAMB'
\$FDAD	-595	MODSCHK	MONITOR MEMORY LOCATION 'MODSCHK'
\$FDB3	-589	XAM	MONITOR MEMORY LOCATION 'XAM'
\$FDB6	-586	DATAOUT	MONITOR MEMORY LOCATION 'DATAOUT'
\$FDC5	-571	RTS4C	MONITOR MEMORY LOCATION 'RTS4C'
\$FDC6	-570	XAMPM	MONITOR MEMORY LOCATION 'XAMPM'
\$FDD1	-559	ADD	MONITOR MEMORY LOCATION 'ADD'
\$FDDA	-550	PRBYTE	MONITOR S/R TO PRINT CONTENTS OF ACC AS 2 HEX DIGITS
\$FDE3	-541	PRHEX	MONITOR S/R TO PRINT A HEX DIGIT
\$FDE5	-539	PRHEXZ	MONITOR MEMORY LOCATION 'PRHEXZ'
\$FDED	-531	COUT	MONITOR S/R TO OUTPUT CHAR IN ACC. CLOBBERS ACC~Y-REG~COUT.
\$FDF0	-528	COUT1	MONITOR S/R TO GET MONITOR CHARACTER OUTPUT
\$FDF6	-522	COUTZ	MONITOR MEMORY LOCATION 'COUTZ'
\$FE00	-512	BL1	MONITOR & MINIASSEMBLER MEMORY LOCATION 'BL1'
\$FE04	-508	BLANK	MONITOR MEMORY LOCATION 'BLANK'
\$FE0B	-501	STOR	MONITOR MEMORY LOCATION 'STOR'
\$FE17	-489	RTS5	MONITOR MEMORY LOCATION 'RTS5'
\$FE18	-488	SETMODE	MONITOR MEMORY LOCATION 'SETMODE'
\$FE1D	-483	SETMDZ	MONITOR MEMORY LOCATION 'SETMDZ'
\$FE20	-480	LT	MONITOR MEMORY LOCATION 'LT'
\$FE22	-478	LT2	MONITOR MEMORY LOCATION 'LT2'
\$FE2C	-468	MOVE	MONITOR S/R TO PERFORM A MEMORY MOVE (A1-A2 TO A4)
\$FE36	-458	VFY	MONITOR S/R TO PERFORM A MEMORY VERIFY
\$FE38	-424	VFYOK	MONITOR MEMORY LOCATION 'VFYOK'
\$FE5E	-418	LIST	CALL TO DISASSEMBLE 20 INSTRUCTIONS
\$FE63	-413	LIST2	MONITOR MEMORY LOCATION 'LIST2'
\$FE78	-392	A1PCLP	MONITOR & MINIASSEMBLER MEMORY LOCATION 'A1PCLP'
\$FE7F	-385	A1PCRTS	MONITOR MEMORY LOCATION 'A1PCRTS'
\$FE80	-384	SETINV	MONITOR MEMORY LOCATION 'SETINV'
\$FE84	-380	SETNORM	MONITOR MEMORY LOCATION 'SETNORM'
\$FE86	-378	SETIFLG	MONITOR MEMORY LOCATION 'SETIFLG'
\$FE89	-375	SETKBD	MONITOR MEMORY LOCATION 'SETKBD'
\$FE8B	-373	IMPORT	MONITOR MEMORY LOCATION 'IMPORT'
\$FE8D	-371	INPRT	MONITOR MEMORY LOCATION 'INPRT'
\$FE93	-365	SETVID	MONITOR MEMORY LOCATION 'SETVID'
\$FE95	-363	OUTPORT	MONITOR MEMORY LOCATION 'OUTPORT'
\$FE97	-361	OUTPRT	MONITOR MEMORY LOCATION 'OUTPRT'
\$FE98	-357	IOPRT	MONITOR MEMORY LOCATION 'IOPRT'
\$FEA7	-345	IOPRT1	MONITOR MEMORY LOCATION 'IOPRT1'
\$FEA9	-343	IOPRT2	MONITOR MEMORY LOCATION 'IOPRT2'
\$FEB0	-336	XBASIC	MONITOR S/R TO JUMP TO BASIC
\$FEB3	-333	BASCONT	MONITOR S/R TO CONTINUE BASIC
\$FEB6	-330	GO	MONITOR MEMORY LOCATION 'GO'
\$FEBF	-321	REGZ	MONITOR MEMORY LOCATION 'REGZ'
\$FEC2	-318	TRACE	CALL TO PERFORM MONITOR TRACE
\$FEC4	-316	STEPZ	MONITOR MEMORY LOCATION 'STEPZ'
\$FECA	-310	USR	MONITOR MEMORY LOCATION 'USR'
\$FECB	-307	WRITE	MONITOR S/R TO WRITE TO CASSETTE TAPE
\$FED4	-300	WR1	MONITOR MEMORY LOCATION 'WR1'
\$FEED	-275	WRBYTE	MONITOR MEMORY LOCATION 'WRBYTE'
\$FEFF	-273	WRBYT2	MONITOR MEMORY LOCATION 'WRBYT2'
\$FEF6	-266	CRMON	MONITOR MEMORY LOCATION 'CRMON'
\$FEFD	-259	READ	CALL TO READ FROM TAPE - LIMITS A1 & A2
\$FF02	-254	READX1	HI-RES GRAPHICS - READ WITHOUT HEADER
\$FF0A	-246	RD2	MONITOR MEMORY LOCATION 'RD2'
\$FF16	-234	RD3	MONITOR MEMORY LOCATION 'RD3'
\$FF2D	-211	PRERR	MONITOR S/R TO PRINT "ERR" AND SOUND BELL. CLOBBERS ACC & Y-REG
\$FF3A	-198	BELL	MONITOR S/R TO PRINT BELL. CLOBBERS ACC~Y-REG
\$FF3A	-198	BELL	CALL HERE TO OUTPUT BELL
\$FF3F	-193	RESTORE	MONITOR & SWEET-16 MEMORY LOCATION 'RESTORE'
\$FF44	-188	RESTR1	MONITOR MEMORY LOCATION 'RESTR1'
\$FF4A	-182	SAVE	MONITOR & SWEET-16 MEMORY LOCATION 'SAVE'
\$FF4C	-180	SAV1	MONITOR MEMORY LOCATION 'SAV1'
\$FF59	-167	RESET	CALL HERE HAS SAME EFFECT AS PUSHING RESET BUTTON
\$FF65	-155	MON	MONITOR S/R- NORMAL ENTRY TO 'TOP' OF MONITOR WHEN RUNNING
\$FF69	-151	MONZ	MONITOR S/R TO RESET AND ENTER MONITOR
\$FF73	-141	NXTITM	MONITOR MEMORY LOCATION 'NXTITM'
\$FF7A	-134	CHRSRCH	MONITOR MEMORY LOCATION 'CHRSRCH'
\$FF7C	-132	ZMODE	MONITOR & MINIASSEMBLER MEMORY LOCATION 'ZMODE'
\$FF8A	-118	DIG	MONITOR MEMORY LOCATION 'DIG'
\$FF90	-112	NXTBIT	MONITOR MEMORY LOCATION 'NXTBIT'
\$FF98	-104	NXTBAS	MONITOR MEMORY LOCATION 'NXTBAS'
\$FFA2	-94	NXTBS2	MONITOR MEMORY LOCATION 'NXTBS2'
\$FFA7	-89	GETNUM	MONITOR & MINIASSEMBLER MEMORY LOCATION 'GETNUM'
\$FFAD	-83	NXTCHR	MONITOR MEMORY LOCATION 'NXTCHR'
\$FFBE	-66	TOSUB	MONITOR & MINIASSEMBLER MEMORY LOCATION 'TOSUB'
\$FFC7	-57	ZMODE	MONITOR MEMORY LOCATION 'ZMODE'
\$FFCC	-52	CHRTBL	MONITOR & MINIASSEMBLER MEMORY LOCATION 'CHRTBL'
\$FFE3	-29	SUBTBL	MONITOR MEMORY LOCATION 'SUBTBL'
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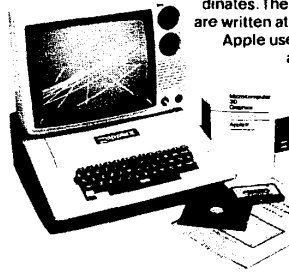
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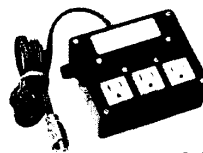
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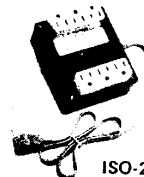
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Mike Rowe
P.O. Box 6502
Chelmsford, MA 01824

Name: **APPLE-80**
System: **APPLE II**
Memory: **16K**
Language: **Integer BASIC (manual), Machine Language (APPLE-80 interpreter)**
Hardware: **Standard APPLE II, 16K**, game paddles for variable speed trace.

Description: With APPLE-80, your APPLE II RAM from 1000 HEX up becomes 8080 programming space. Single-Step or Trace with all 8080 registers dynamically displayed on APPLE's screen. When your 8080 program is fully de-bugged, let it run — you have full access to all APPLE I/O routines via the special C65 instruction, which also lets you call user-written 6502 subroutines directly from your 8080 program. 8080 I/O ports are arranged in a table for ease of user modification. Up to 8 non-destructive breakpoints may be set to facilitate program debugging. 8080 routines may also be imbedded in the middle of 6502 programs, saving tedious translation. Educators and students will benefit from APPLE-80's clear illustration of the inner workings of the 8080. APPLE-80 is suitable for all but time-dependent applications.

Copies: **45 +**
Price: **\$20.00 + \$1.50** Shipping & handling. California residents must add 6% sales tax.

Includes: APPLE-80 manual and APPLE-80 program on cassette, 8080 time-of-day clock demonstration program (illustrates use of APPLE II I/O from 8080 programs), and APPLE-80 ready reference card. Source NOT INCLUDED.

Order Info: Send Check or Money Order

Author: **Dann McCreary**

Available from:

Dann McCreary
Box 16435-M
San Diego, California 92116

Name: **FLEET**
System: **PET**
Memory: **8K**
Language: **Machine Language**
Hardware: **Standard Pet**

Description: FLEET is a game where the object is to find and destroy all of the enemy's ships. The program is designed to make optimum use of the features of the Commodore Pet, such as its graphic and sound producing capabilities. FLEET is written in machine language but has been specially recorded so that it can be loaded

with the LOAD command, and it automatically runs after being loaded.

Copies: **Just Released**
Price: **\$7.95**

Includes: Cassette with two versions of FLEET (one with sound effects and one without), manual, and instructions on how to hook up a music box to your PET.

Author: **William Robinson**

Available from:
PETRONICS
18431 Kingsport
Malibu, Ca. 90265

Name: **APPLESHIFT**
System: **APPLE II**
Memory: **16K** for tape version, **24K** for Disk II version
Language: **Integer BASIC and 6502 machine language**
Hardware: **APPLE II, tape recorder or Disk II, and printer**

Description: A package allowing conventional use of the APPLE II keyboard shift keys, containing instructions for hardware modification, machine language subroutines for input and display, an Integer BASIC demonstration program called TEXTPAGE, and complete documentation.

TEXTPAGE allows you to enter, edit, store on disk, and print (using your own printer driver) a page of text (55 lines of 80 characters each). The primary purpose of the package is to show you how to modify your apple and use our subroutines with your programs but TEXTPAGE functions nicely as a "mini" word processor. A complete word processor called APPLETEXT (the only complete word processor for the APPLE II to allow normal use of the shift keys!) is also available. Registered APPLESHIFT packages may be returned for complete credit toward APPLETEXT packages. Both products may be used with Dan Paymar's lower case adaptor or as stand-alone products, with lower case appearing on the screen as upper case in normal mode and upper case appearing as upper case in inverse mode.

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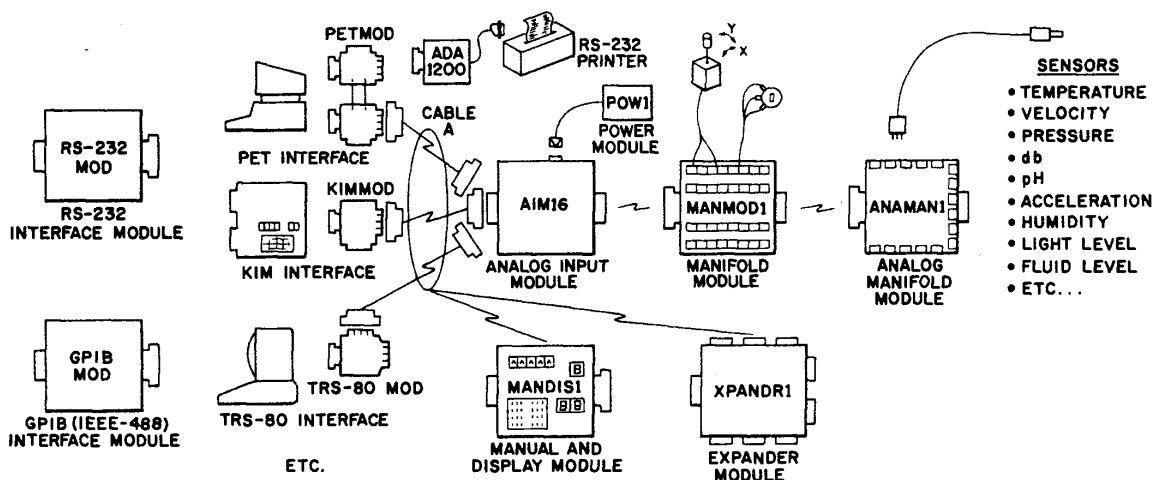
Author: **C&H Micro**
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Interfacing the Analog Devices 7570J A/D Converter

Dr. Marvin L. De Jong
Department of Mathematics and Physics
The School of the Ozarks
Point Lookout, MO 65726

Complete interfacing information, including a demonstration program, will make real time applications responsive to external events when you add this top of the line analog-to-digital converter to a 6502 system.

If you want to go first class in analog-to-digital converters, you ought to consider the AD-7570J marketed by Analog Devices, 1 Industrial Park, Box 280, Norwood, MA 02062. It is a 28 pin, monolithic CMOS 8-bit successive approximation A/D converter specifically designed for interfacing with microprocessors. The data lines are three-state lines, and consequently may be connected to the data bus of a microcomputer.

An interface between a 6530 PIA and the 7570 is described in this article. In the near future, I hope to describe an interface directly to the data bus of a 6502 system. A demonstration program to control the A/D converter is also given. The interface circuitry and program should be applicable to any 6502 system with a MOS PIA, such as the 6530, or a VIA such as the 6522.

The circuit is shown in the figure. It differs from the one given on the 7570 specification sheet, supplied with the chip, only in the comparator which was used. I used an LM318 op amp simply because I did not have a 311 comparator handy. The AD311 or LM311 is recommended because it was designed for voltage comparisons, whereas the LM318 is a high-class op amp.

The 7570 has an internal clock which can be used by adding a resistor-capacitor network, but I chose to use the clock signal from the 6502 (either O₂ or O₁) which was divided by ten using the 7490. This arrangement gives the necessary phase relationship between

the CLK and the STRT signals on the 7570.

A Zener diode provided the necessary reference voltage. STRT, BSEN, LBEN and HBEN are active high control signals. Since the 6502/6530 "comes up" with highs on the output ports, I used a 74004 inverter between the control port PB0-2 and the control inputs on the 7570. The CMOS version of the 7404 is not necessary; a 74L04, LS04, or just a plain old 7404 may be used. The CMOS version of the 7490 should not be used in the divide-down circuit because of propagation delays which might destroy the necessary phase relationships.

So much for the circuit. The reader is urged to study the 7570 spec sheet for additional details. Bipolar operation is possible, for example, and details regarding settling time, layout, and grounding are also quite important.

Conversion is initiated by applying a positive pulse to the STRT pin. The pulse must be at least 500 nanoseconds in duration, and conversion begins on the trailing edge of the pulse. The BSEN pin next receives a logical 1 from the computer. This is an interrogation signal. If the converter is still busy, the **BUSY** pin is low, putting a zero on the PA7 line. If the conversion is complete, a one will appear on the PA7 line. If the BSEN pin is low, the **BUSY** pin is in its high impedance state.

Once the conversion is complete, BSEN is brought low, and HBEN and

LBEN are placed at logic 1 by the microcomputer. This results in the conversion data appearing at pins DB2-9 to be read by the A-port on the 6530. While HBEN and LBEN are low, the data pins are in their high impedance state.

The reason for having both LBEN and HBEN is simply that a ten bit version of the same chip (7507L) is available, and HBEN puts the two highest bits on the bus, while LBEN puts the low order bits on the bus. This also explains why DB0 and DB1 are not used. The ten bit version is also more expensive.

The program, while written for the KIM-1, demonstrates how the 6502 microprocessor and 6530 PIA control the A/D converter. The comments cover the details quite well. Clearly, the machine language details will be different for a system other than the KIM-1, but the mnemonics will remain the same.

What might you do with an A/D converter? If you are a game nut, you might attach the ANALOG IN signal to the center tap of a pot and call it a joy stick, I think. You want two, three, four joy sticks? Don't get four of these expensive A/D converters; get an analog multiplexer such as the 4052.

Use the same device and the same reference (Lancaster) to build a programmable digital voltmeter. Speech recognition circuits convert the filtered and rectified voice signal to a digital value using A/D converters. Here is a real opportunity to help the seriously handicapped person.

Get a pressure transducer and use your A/D converter to monitor pulse rates and measure blood pressure automatically. Processing analog signals with digital techniques, averaging, filtering, etc. is also an interesting area for experimentation. Finally, document your experiment and send it away to be published in one of the hobby magazines, such as MICRO, so the rest of us can benefit from your work.

Reference:

Lancaster, D., *CMOS Cookbook*, Howard W. Sams & Co., Inc., Indianapolis, 1977.

SPEECHLABTM, Heuristics, Inc., 900 N. San Antonio Rd., Los Altos, CA 94022.

Pressure Transducer Handbook, National Semiconductor Corp., Santa Clara, CA 95051.

Analog-Digital Conversion Handbook, Analog Devices, Norwood, MA 02062, 1972.

```

0010:          * A/D CONVERTER DEMONSTRATION PROGRAM
0020:          * MODIFIED 7/4/79 BY MICRO STAFF
0030: 032D      SCANDS *      $1F1F
0040: 032D      PAD *        $1700
0050: 032D      PBD *        $1702
0060: 032D      PBDD *       $1703
0070: 032D      INH *        $00F9
0080: 0300      ORG      $0300
0090: 0300 A9 07      START LDAIM $07  A/D CONTROL PINS SET TO
0100: 0302 8D 02 17    STA  PBD  LOGICAL 0 VIA PBD-2 WHEN
0110: 0305 8D 03 17    STA  PBDD  DIRECTION REGISTER IS ALSO SET
0120: 0308 CE 02 17    AGN  DEC  PBD  TOGGLE STRT PIN TO INITIATE
0130: 030B EE 02 17    INC  PBD  CONVERSION
0140: 030E A9 05      LDAIM $05  ACTIVATE BSEN TO CHECK BUSY
0150: 0310 8D 02 17    STA  PBD
0160: 0313 AD 00 17    BACK LDA  PAD  CHECK BIT 7 ON PAD (BUSY) TO
0170: 0316 10 FB      BPL  BACK  SEE IF CONVERSION IS COMPLETE
0180: 0318 A9 03      LDAIM $03  SET HBEN & LBEN TO LOGIC 1 TO
0190: 031A 8D 02 17    STA  PBD  PUT DATA ON THE LINES
0200: 031D AD 00 17    FINISH LDA  PAD  DIGITAL DATA IS NOW IN
0210: 0320 85 F9      STA  INH  ACCUMULATOR KIM-1 USERS MAY
0220: 0322 20 1F 1F    JSR  SCANDS WISH TO DISPLAY THE RESULT
0230: 0325 A9 07      LDAIM $07  INITIALIZE CONTROL PINS TO ZERO
0240: 0327 8D 02 17    STA  PBD  AND THEN
0250: 032A 4C 08 03    PRGEND JMP  AGN  START ANOTHER CONVERSION
ID=

```

-T-

SYMBOL TABLE 2000 203C

AGN	0308	BACK	0313	FINISH	031D	INH	00F9
PAD	1700	PBDD	1703	PBD	1702	PRGEND	032A
SCANDS	1F1F	START	0300				

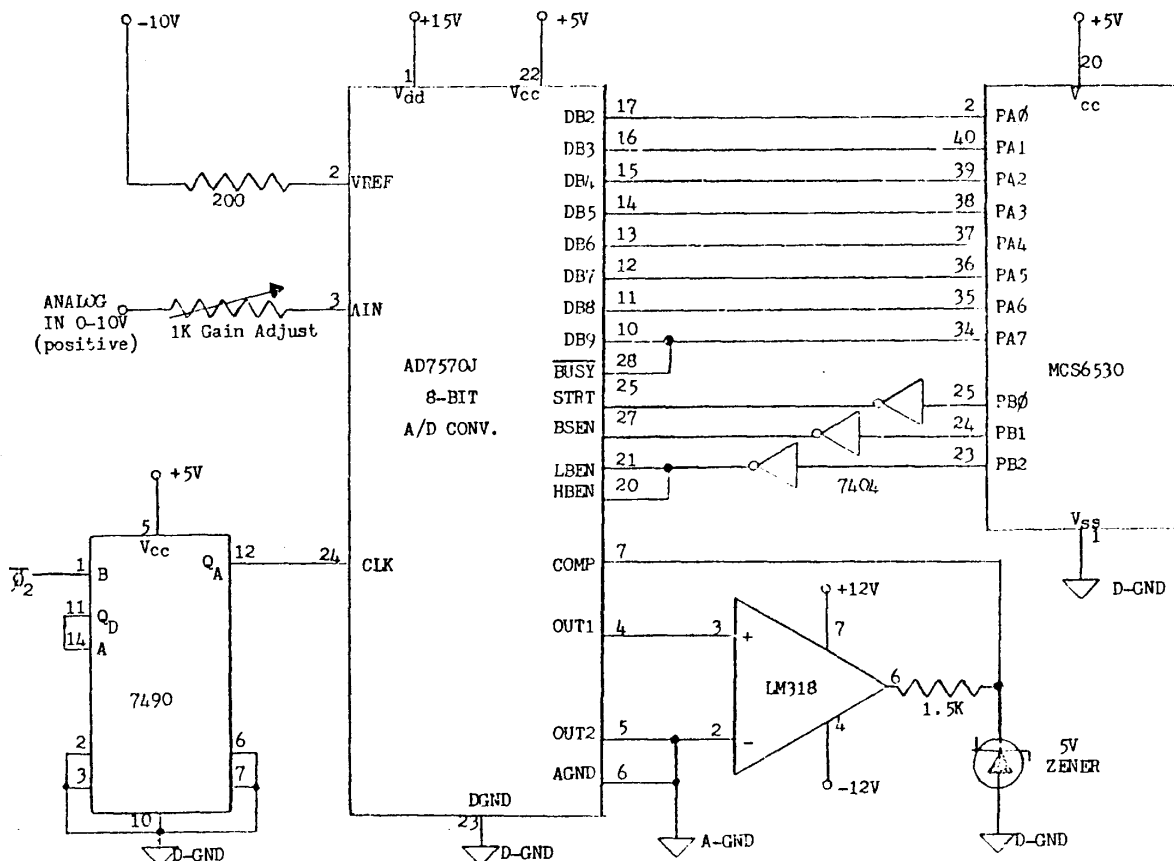


Figure 1: Interface circuit. An LM311 voltage comparator is recommended instead of the LM318 op amp. D-GND is short for digital ground, and

A-GND stands for analog ground. The 6530 is assumed to be part of a microprocessor.

SYMple Memory Expansion

John M. Blalock
3054 West Evans Drive
Phoenix, AZ 85023

An 8K SYM from a board small enough to fit in the Synertek logo area of a standard enclosure? This interesting modification may violate good engineering practices, but it is difficult to argue with the designer's result.

Synertek states in their SYM-1 manual, "it is believed that most users of the SYM-1 will ultimately use a TTY". I disagree. Most users, like me, will probably use some type of CRT terminal. The full power of the SYM monitor is not really appreciated until you connect it to a CRT or TTY. No wonder that Synertek made such a statement in the manual. The addition of a terminal turns the SYM into quite a little computer!

There is only one drawback to adding the terminal. Once you have it connected, you'll need to expand the SYM's memory to keep up with the larger programs, interpreters, and assemblers that you are sure to come up with!

Tiny Basic

One of the easiest and least expensive additions that can be made to the SYM, after the addition of a TTY or CRT, is Tom Pittman's Tiny Basic. It is only \$5.00 in paper tape format from him at Itty Bitty Computers, PO Box 23189, San Jose, CA 95153. Several ASK dealers sell it on cassette for \$10.00. Get Version V.1K for the 6502 that starts at 0200 hex. It will fit from \$0200 to \$0AFF, leaving \$0B00 to \$0FFF available for programs. Since the SYM already includes a Break Test routine in its monitor, it is even simpler to interface Tiny Basic to the SYM than to the KIM. Make the following patches:

0206	4C	1B	8A	JMP INCHR
0209	4C	47	8A	JMP OUTCHR
020C	4C	3C	8B	JMP TSTAT

I also made the following optional

changes to my copy:

020F	08	Changes the character correction code to the ASCII backspace code.
0210	40	Changes the line cancel code to the "@" sign.
0971	2A	Changes the prompt character from "colon" to "asterisk".

Memory Limitations

Tiny Basic is a very good interpreter, for its size, but only 1024 bytes are left out of the SYM's 4K RAM for Tiny Basic programs. I had an extra pair of 2114s on hand after I got Tiny up and running, and decided to see if there wasn't some way that I could make use of them.

I removed 2114s U12 and U13 from their sockets, mounted the extra two 2114s on top of them in the so called "piggyback" fashion, and soldered all pins of the extra 2114s to the same pins on the originals, except that the pin 8s were left unconnected.

I attached 30 GA wire to these pins on the two added 2114s, making sure that they were well insulated from the pin 8s of the original 2114s. The original ICs were then plugged back into the SYM and a memory test was run. So far, so good.

U1, a 74LS138, is a decoder that divides the first 8K of the SYM's memory into 1K blocks. The signals from it that correspond to the first four 1K blocks are used as the chip select signals for the original 2114s. The wires from pin 8 of the two added 2114s were wired to the

fifth signal from U1, which is at pin 11 of its package.

Repeating the memory test, I had 5K of memory! I had just doubled the memory space available for Tiny Basic! Could it be expanded further? Perhaps, but not this way. The 2114s were too close together and got hotter than I would like to see them get.

Bumble Bees Can't Fly

The address and data lines from the 6502 are only guaranteed to drive up to 1 TTL load and 130 pf of capacitance. No buffers exist on the SYM to reduce the loading. Adding up the capacitance of all the devices already on the SYM that are wired to the data and address buses, and adding a conservative figure for the capacitance of all the PC traces themselves, shows that the 6502 is being pushed to its limit already.

But those values of capacitance from the spec sheets are maximum values, while the 130 pf is a minimum. Let's try! The goal is to fit it in over the logo and Synertek name.

I built up a small perf board with IC sockets and wired them together using a wiring pencil and 36 GA solder strip-pable wire. Nine sockets were on the board, and an 18-pin homemade DIP plug plugged into the SYM's U19 socket to pick up most of the required connections.

Additional wires were run to the data lines at U12, and to the chip select signals from U1. It worked! I had an 8K SYM! And the board was small enough

to fit in the area of the Synertek logo and name, between U1 and the original memory chips.

Several other SYM owners were very interested in my design, even though it violates good engineering practices. Enough interest was shown to commit the schematic of Figure 1 to an artwork and make up a few dozen copies of the board. This version is much neater than the prototype.

The board is double sided and has plated through holes. Two 16-pin DIP jumpers connect from it to the SYM's U12 and U19 sockets. (Ever try to buy an 18-pin jumper?) Four wires run from the board to pins of U1. U12, U19, and eight other 2114s mount on the final board.

None of the copies built to date have failed to work satisfactorily, nor does an oscilloscope show any degradation of the 6502's signals. My SYM has U20, U21, U22, U23, and U28 installed, so it is close to a worst case. I have had several dozen blank PC boards made which I will make available to other SYM owners for \$5.00 each, with instructions. Please include a self addressed stamped envelope.

Results

I will have to admit that the added board is an expansion to the SYM, but it

certainly doesn't expand its size by much, does it? Tiny Basic now has 5K for its programs, a pretty respectable amount of memory. Synertek's BASIC, which is excellent, has 7679 bytes free, at initialization, instead of 3585. Many of the applications that I had only con-

sidered running on my KIM (29+ RAM!) system are now being run on the SYM, due to the faster tape interface, sufficient memory, BASIC in ROM, and the capabilities of the SYM's monitor.

It was certainly worth the trouble to try, even if bumble bees can't fly!

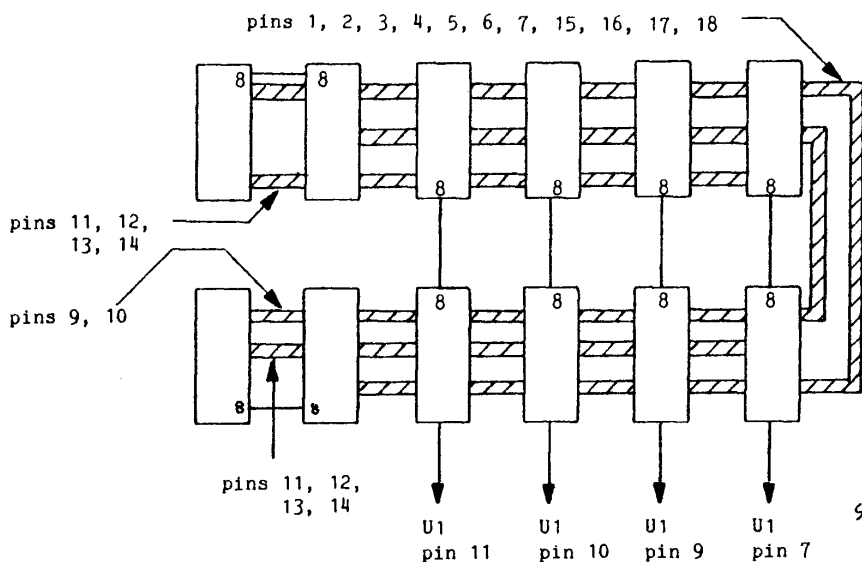


Figure 1: W7AAY Sym-1 Memory Expansion

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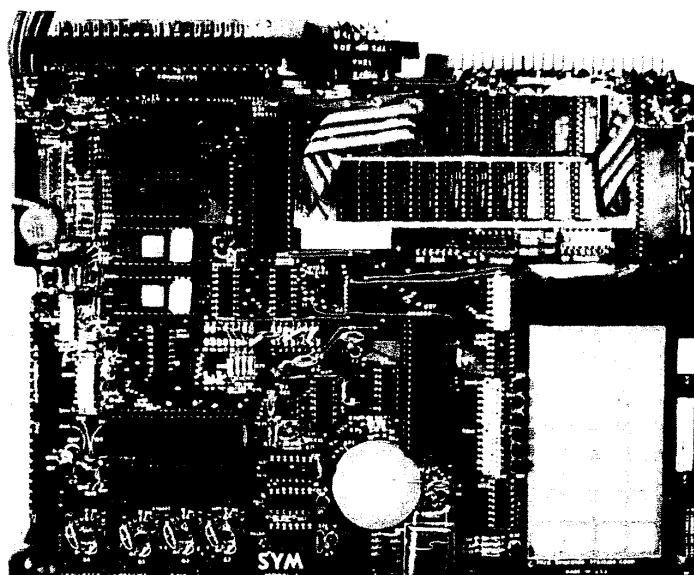


Figure 2: The 8K SYM.

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Now: a machine language programming powerhouse for the knowledgeable programmer who wants to extend the PET's capabilities to the maximum. The MacroTeA, the Relocating Macro Text Editor:Assembler from Skyles Electric Works.

The Skyles MacroTeA is a super powerful text editor. 27 powerful editing commands. String search and replace capability. Manuscript feature for letters and other text. Text loading and storage on tape or discs. Supports tape drives, discs, CRT, printers and keyboard.

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There's no tape loading and no occupying of valuable RAM memory space: The Skyles MacroTeA puts 9K bytes of executable *machine language* code in ROM (from 9C00 to BFFF — directly below the BASIC interpreter).

Like all Skyles Products for the PET, it's practically **plug in and go**. No tools are needed. And, faster than loading an equivalent size assembler/editor from tape, the MacroTea is installed permanently.

Define HI-RES Characters for the APPLE II

**This program makes it easy to generate and modify
HI-RES characters on the APPLE II.**

Robert F. Zant
Department of Accounting
and Information Systems
North Texas State University
Denton, TX 76203

The user contributed library of programs, Volumes 3, 4, and 5, recently released by the Apple Computer Company, contains a machine language routine for generating characters using the HI-RES features of the APPLE II. The package also includes a character table that contains 128 predefined characters.

The characters are represented in the table in a coded, reverse image format. The code is based on a 7 by 8 dot matrix representation for each character. The format for an "L" is depicted below. Note that a border is left at the top and side so that characters will be separated on the screen.

[illegible]

The coded table entry is derived from the format by substituting a zero for each dot and a one for each asterisk. Each line of the matrix is thereby coded into one byte. The high order bit is set to zero in each byte. Eight bytes are required to encode each character. The code for the "L" depicted above would be

02, 02, 02, 02, 02, 42, 7E, 00

The following program assists in defining characters and substituting them into the character table. Each character is defined in a regular dot matrix format, rather than in reverse image. The program automatically calculates the binary code for the equivalent rotated version. The letter "L" would be entered as:

• 書
• 書
• 書
• 書
• 書
• 書
• 書
• 書書書書書

Note that the dot matrix must remain intact, and must contain only dots and asterisks. The command to store the character, the CTRL S, must be entered after the matrix, on the ninth line. A carriage return is required after each command.

At the beginning of the run, the operator specifies the table position (0 to 127) for the first character to be defined. Thereafter, characters are automatically stored at succeeding locations in the table. Separate runs of the program can be used to define characters in non-contiguous table locations.

The Skyles MacroTeA: 11 chips on a single PCB. Operates interfaced with the PET's parallel address and data bus or with the Skyles Memory Connector.

(When ordering, indicate if the MacroTeA will interface with a Skyles Memory Expansion System. You can save \$20.) Specifications and engineering are up to the proven Skyles quality standards. Fully warranted for 90 days. And, as with all Skyles products, fully and intelligently documented.



Skyles Electric Works

10301 Stonydale Drive Cupertino, CA 95014
(408) 735-7891

ASSEMBLE LIST

```

0100 :MOVE TBL 1 TO TBL2
0110 :BA $400
0400— A/ 0B 0120 LOOP LDY #00
0402— B9 0B 04 0130 LDA TBL1.Y
0405— 89 0B 05 0140 STA TBL2.Y
0408— C8 0150 INY
0409 D0 F7 0160 BNE LOOP
0170 :
040B 0180 TBL1 DS 256
050B 0190 TBL2 DS 256
0200 :
0210 EN

```

LABEL FILE 1 = EXTERNAL

```
START = 0400      LOOP = 0402      TBL1 = 040B
TBL2 = 050B
110000 060B 060B
```

```

50 REM
60 REM ASSUMES CHARACTER TABLE
70 REM BEGINS AT #6800
80 REM
90 REM
100 TEXT : CALL -936
200 VTAB 5: PRINT "ENTER DECIMAL EQUIVALENT"
300 PRINT "OF FIRST (ASCII) CHARACTER"
350 PRINT "(MAXIMUM VALUE OF 127)"
400 INPUT B
425 IF B>=0 AND B<128 THEN 450: PRINT "RE-ENTER": GOTO 400
450 B=26624+B*8
500 CALL -936
600 PRINT "CHANGE THE DOTS IN THE FOLLOWING MATRIX"
700 PRINT "TO ASTERISKS TO DESCRIBE A FIGURE."
750 PRINT "USE (ESC C) (ESC D) (ESC E) AND (ESC F) TO EDIT"
775 PRINT "(LEAVE DOTS THAT ARE NOT REPLACED.)"
800 PRINT "ENTER A (CTRL S) TO STORE THE FIGURE."
900 PRINT "ENTER A (CTRL Q) TO QUIT."
1000 REM PRINT MATRIX
1100 VTAB 9
1200 FOR I=0 TO 7
1300 PRINT "....."
1400 NEXT I
1500 VTAB 9
2000 REM GET INPUT CHARACTER
2100 CALL -657
2200 IF PEEK (512)=147 THEN 3000
2300 IF PEEK (512)=145 THEN 9000
2500 GOTO 2000
3000 REM ENCODE CHARACTER
3050 A=B: REM SAVE BEGINNING OF CHARACTER
3100 REM LOOK THRU MATRIX
3200 FOR I=1064 TO 1960 STEP 128
3250 C=0
3300 FOR J=0 TO 6
3400 IF PEEK (I+J)=174 THEN 3700
3500 IF PEEK (I+J)<>170 THEN 4000
3600 C=C+2 * J
3700 NEXT J
3800 POKE B, C: B=B+1
3900 NEXT I
3950 GOTO 1000
4000 REM ERROR IN MATRIX
4100 VTAB 20
4200 PRINT "MATRIX CONTAINS INVALID CHARACTER"
4250 PRINT "RE-ENTER": B=A
4300 FOR I=0 TO 1000: NEXT I
4400 VTAB 20: CALL -958
4500 GOTO 1500
9000 END

```

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HELP	TRACE	STEP
OFF	APPEND	DUMP
FIND	UNLIST	

Every one a powerful command to insure more effective programming. Like the **HELP** command that shows the line on which the error occurs... and the erroneous portion is indicated in reverse video:

```

HELP
500 J = SQR(A*B/(C))
READY

```

...Or the **TRACE** command that lets you see the sequence in which your program is being executed in a window in the upper corner of your CRT:

```

TRACE
READY.
RUN
#100
#110
#150

```

The **Programmer's Toolkit** is a product of Harry Saal and his associates at Palo Alto ICs, a subsidiary of Nestar Systems, Inc. Dr. Saal is considered a leading expert in the field of personal computers and the Nestar System is considered to be the ultimate multiple microcomputer program storage system.

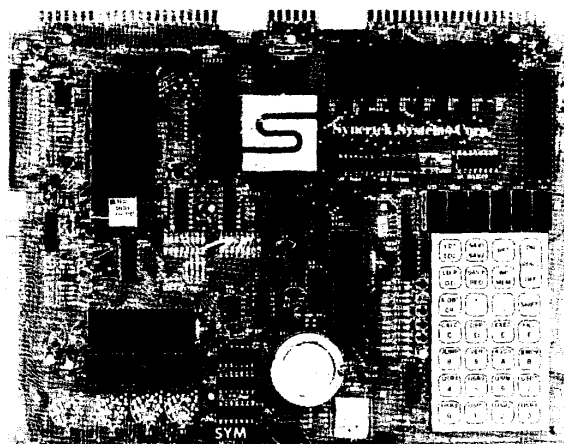
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Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

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VAK-2 16K RAM Board with only 8K of RAM (1/2 populated)	\$239.00
VAK-3 Complete set of chips to expand above board to 16K	\$175.00
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This board requires a +5 VDC and +12 VDC, but has a DC to DC

multiplier so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer	\$269.00
------------------------------------	-----------------

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. EPROMs not included.

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--------------------------	-----------------

VAK-7 COMPLETE FLOPPY-DISK SYSTEM (May '79)

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Common Variables on the APPLE II

Modular software designs rely on common variables to pass data between interrelated programs. Two short subroutines emulate the DOS CHAIN capability by allowing use of common variables under Integer or Applesoft BASIC, without a disk.

Professor Robert F. Zant
Department of Accounting
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North Texas State University
Denton, TX 76203

The solution of complex problems often leads to the writing of several interrelated programs. Furthermore, the programs usually use several of the same variables — called common variables. This is accomplished in most systems by not destroying the common variables when a new program is loaded. Thus, the value of a variable can be defined in one program and used in subsequent programs.

There is no true facility with the APPLE II for using common variables. The CHAIN command in DOS comes close to providing the capability, but it saves all variables instead of just saving designated common variables. Also, it can only be used with Integer BASIC programs run under DOS. No facility for common variables is provided for non-disk systems or for Applesoft programs.

The attached machine language routines can be used to pass all variables to succeeding programs. Integer BASIC and Applesoft versions are provided. Both versions are used as follows:

1. Load the machine language routine before the first BASIC program is executed.
2. In each BASIC program except the last program, "CALL 774" immediately before termination or before the DOS command to RUN the next program.
3. In each BASIC program except the first program, "CALL 770" before executing any statement that affects or uses variables. Do not reDIMension variables in subsequent programs.

Since all variables are saved whether they are needed or not, main storage is used most efficiently if the same set of variable names is used in all programs. This, of course, is required for the variables that are intended to be common for all programs. Other main storage is reclaimed by the reuse of the names of "non-common" variables.

String variables will not always be saved correctly in Applesoft. If the string value was read from disk, tape or keyboard, the

value will be saved. If the string value is defined in an assignment statement (e.g. A\$ = "XXX"), the value will not be available to subsequent programs.

The routine for Integer BASIC is very simple. The variable table pointer is simply saved and restored. The Ap-

pleSoft version, however, is a little more complex. The Applesoft version of the routine moves all non-string variables to high RAM, just under the strings. Then, when called at the beginning of the next program, via "CALL 770", the routine moves the variables back down to the end of the new program.

```

0030:                                * ROUTINE TO SAVE AND RECALL
0040:                                * COMMON VARIABLES FOR APPLESOFT II BASIC
0050:                                * PROGRAMS ON THE APPLE II
0060:                                *
0070:                                * WRITTEN 03/16/79 BY ROBERT F. ZANT
0090:                                *
0100: 03A7 DL * $0018
0110: 03A7 DH * $0019
0120: 03A7 CL * $001A
0130: 03A7 CH * $001B
0140: 03A7 EL * $001C
0150: 03A7 EH * $001D
0160: 03A7 A1L * $003C
0170: 03A7 A1H * $003D
0180: 03A7 A2L * $003E
0190: 03A7 A2H * $003F
0200: 03A7 A4L * $0042
0210: 03A7 A4H * $0043
0220: 0302 ORG $0302
0230: 0302 4C 56 03 JMP RECALL ***ENTRY 770
0240: 0305 00 BRK
0250: 0306 38 SEC
0260: 0307 A5 6F LDA $006F COMPUTE ADDRESSES FOR MOVE
0270: 0309 85 18 STA DL SAVE START OF STRING ADDRESS
0280: 030B E5 6D SEC $006D END OF NUMERICS
0290: 030D 85 1A STA CL TEMPORARY STORAGE
0300: 030F A5 70 LDA $0070
0310: 0311 85 19 STA DH
0320: 0313 E5 6E SBC $006E
0330: 0315 85 1B STA CH TEMPORARY STORAGE
0340: 0317 18 CLC
0350: 0318 A5 1A LDA CL
0360: 031A 65 69 ADC $0069 START OF NUMERICS
0370: 031C 85 1A STA CL TEMP STORAGE
0380: 031E A5 1B LDA CH
0390: 0320 65 6A ADC $006A
0400: 0322 85 1B STA CH
0410: 0324 A6 1A LDX CL SUBTRACT ONE
0420: 0326 D0 02 BNE A1
0430: 0328 C6 1B DEC CH START OF COMMON
0440: 032A CA A1 DEX
0450: 032B 86 1A STX CL
0460: 032D 86 42 STX A4L SET UP MOVE
0470: 032F A5 1B LDA CH
0480: 0331 85 43 STA A4H
0490: 0333 A5 69 LDA $0069 START OF VARIABLES
0500: 0335 85 3C STA A1L
0510: 0337 A5 6A LDA $006A
0520: 0339 85 3D STA A1H
0530: 033B A5 6D LDA $006D END OF VARIABLES

```

SYBEX

LEADER IN
COMPUTER EDUCATION

```

0343 A0 00      LDYIM $00
0345 20 2C FF   JSR  $FE2C  USE MONITOR MOVE ROUTINE
0348 38         SEC          COMPUTE DISPLACEMENT
0349 A5 6B      LDA  $006E  TO ARRAYS
034B E5 69      SBC  $0069
034D 85 1C      STA  EL
034F A5 6C      LDA  $006C
0351 E5 6A      SBC  $006A
0353 85 1D      STA  EH
0355 60         RTS          BACK TO BASIC

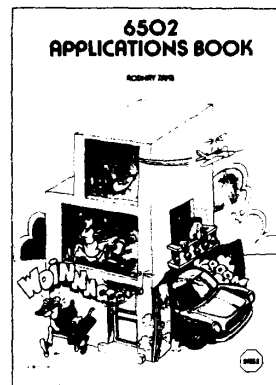
```

```

*
0356 A5 1A      RECALL LDA  CL      ***ENTRY 770 - RECALL
0358 85 3C      STA  A1L  SET UP MOVE
035A A5 1B      LDA  CH
035C 85 3D      STA  A1H
035E A5 18      LDA  DL
0360 85 6F      STA  $006F  START OF STRINGS
0362 85 3E      STA  A2L
0364 A5 19      LDA  DH
0366 85 70      STA  $0070
0368 85 3F      STA  A2H
036A A5 69      LDA  $0069  START OF NUMERICS
036C 85 42      STA  A4L
036E A5 6A      LDA  $006A
0370 85 43      STA  A4H
0372 A0 00      LDYIM $00
0374 20 2C FE   JSR  $FE2C  USE MONITOR MOVE ROUTINE
0377 18         CLC          COMPUTE START
0378 A5 69      LDA  $0069  OF ARRAYS
037A 65 1C      ADC  EL
037C 85 6B      STA  $006B
037E A5 6A      LDA  $006A
0380 65 1D      ADC  EH
0382 85 6C      STA  $006C
0384 38         SEC          COMPUTE END OF NUMERICS
0385 A5 6F      LDA  $006F
0387 E5 1A      SEC  CL
0389 85 6D      STA  $006D
038B A5 70      LDA  $0070
038D E5 1B      SBC  CH
038F 85 6E      STA  $006E  TEMP STORAGE
0391 18         CLC
0392 A5 6D      LDA  $006D
0394 65 69      ADC  $0069
0396 85 6D      STA  $006D  TEMP VALUE
0398 A5 6E      LDA  $006E
039A 65 6A      ADC  $006A
039C 85 6E      STA  $006E  TEMP VALUE
039E A5 6D      LDA  $006D  SUBTRACT ONE
03A0 D0 02      BNE  A2
03A2 C6 6E      DEC  $006E  END OF NUMERICS
03A4 C6 6D      DEC  $006D
03A6 60         RTS          BACK TO BASIC

```

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T

SYMBOL TABLE 2000 205A

AQ	032A	AQH	003D	AQL	003C	AR	03A4
ARR	003F	ARL	003E	ATI	0043	ATL	0042
CH	001B	CL	001A	DH	0019	DL	0018
EH	001D	EL	001C	RECALL	0356		

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Classified Ads

```

0010:
0020:
0030:      * ROUTINE TO SAVE AND RECALL
0040:      * COMMON VARIABLES FOR INTEGER BASIC
0050:      * PROGRAMS ON THE APPLE II
0060:      *
0070:      * WRITTEN 03/16/79 BY ROBERT F. ZANT
0080:      * MODIFIED 7/4/79 BY MICRO STAFF
0090:      *
0100: 0318      CL      *      $001A
0110: 0318      CH      *      $001F
0120: 0302      ORG      $0302
0130: 0302 4C OF 03      JMP      RECALL ***ENTRY 770
0140: 0305 00      BRK
0150: 0306 A5 CC      LDA      $00CC ***ENTRY 774 - SAVE VARIABLES
0160: 0308 85 1A      STA      CL      SAVE END OF
0170: 030A A5 CD      LDA      $00CD VARIABLE TABLE
0180: 030C 85 1B      STA      CH
0190: 030E 60      RTS      BACK TO BASIC
0200:
0210: 030F A5 1A      RECALL LDA      CL      ENTRY 770 - RECALL VARIABLES
0220: 0311 85 CC      STA      $00CC RESET END OF
0230: 0313 A5 1B      LDA      CH      VARIABLE TABLE
0240: 0315 85 CD      STA      $00CD
0250: 0317 60      RTS      BACK TO BASIC

```

OPTIMIZE APPLESOFT programs: shorten variable names; remove remarks & extra colons; concatenate lines; renumber; list variable cross refs. Two 1.3K programs for 16-48K APPLE II's. Cassette \$15, disc \$20 from: Sensible Software P.O. Box 2395 Dearborn, MI 48123

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BAD REVIEW

What's worse than getting a complaint about MICRO that is not valid? Getting one that is! I received a telephone call from Dr. Rodney Zaks the other day concerning a review which was published about his book Programming the 6502 in an earlier issue of MICRO. His complaint was not that the review was unfavorable to his book, but that the "review" went beyond the boundaries of a review and made a number of unwarranted accusations about the techniques, motivations and values of the entire product line offered by SYBEX, the publisher of Dr. Zaks' book. I told Dr. Zaks that I didn't really remember the review, that it was against MICRO's basic policy to print anything of that nature, but that I would look into the matter and if he was correct, I would print an apology and try to rectify the matter as much as possible.

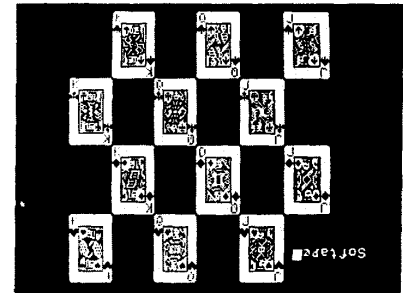
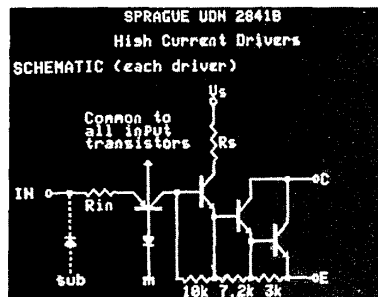
Well, when I read the "review" I was surprised. I agree with Dr. Zaks. While the first part of the review is critical of the book, it is within the rights of a reviewer. The second part of the "review" should not have been printed. It does not provide any useful information to the reader and its negative assertions are unjustified. Since I was both Editor and Publisher at the time the review was printed, I take full blame for its appearance in MICRO, and apologize to Dr. Zaks and SYBEX for its appearance.

Since it is against MICRO's policy to print such material, how did it get printed? All I can figure is that it "fell through the crack". With the very small staff we had at the time, most of our efforts were spent on getting the major articles into shape for publication: technical editing, typesetting, proofing, pasting-up, and so forth. Very little time was left for a careful analysis or review of the small "filler" material, and the "review" never got the attention it should have, and so "slipped in". I suggest that all readers ignore the negative implications of the second half of the review. With the enlargement of the MICRO staff to include a full time editor as well as other support personnel, we have more time and similar problems should not occur.

MICRO has printed very few reviews to date: three book reviews and only a couple hardware or software reviews. The reason for this is that we feel that unsolicited reviews tend to be biased. The author is writing because he either loves or hates a product. We are working on a plan by which MICRO can establish a panel of reviewers and actively start doing product reviews which are both fair and thorough. Information about this plan will appear in MICRO shortly.

Robert M. Trapp

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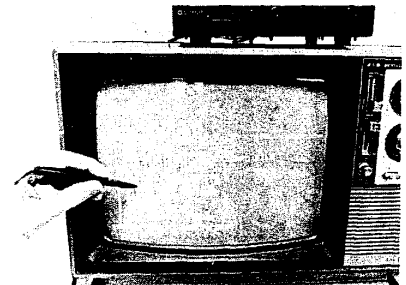
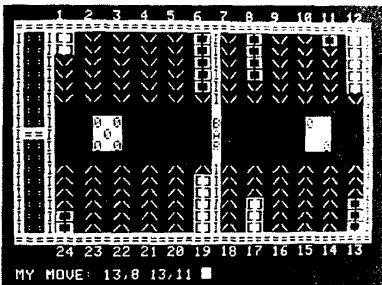
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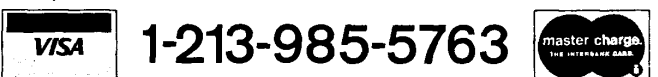
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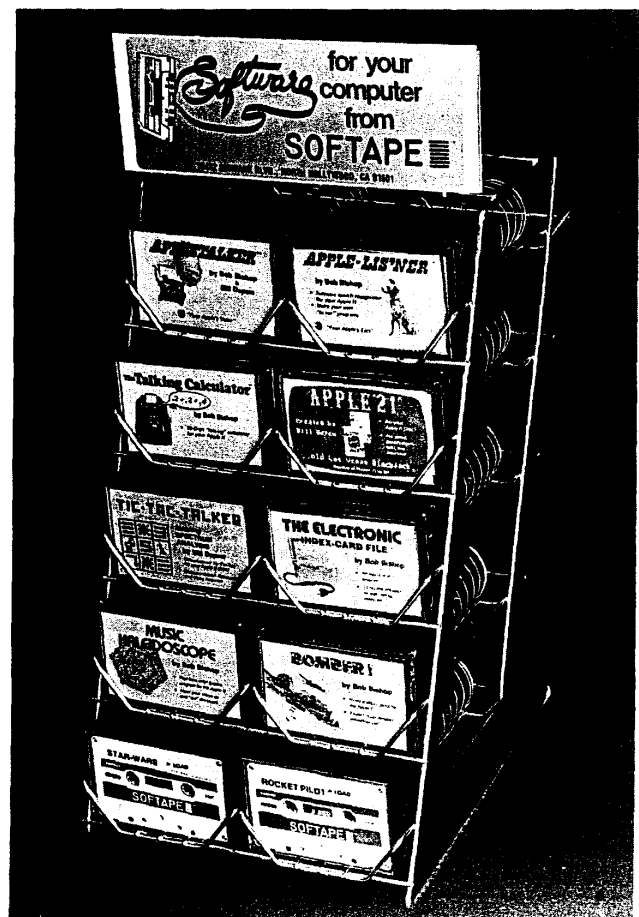


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All text should be typewritten using double or triple spacing and generous left and right margins. Figures and illustrations should be drawn neatly, either full size or to scale, exactly as they will appear in MICRO. Photographs should be high contrast glossy prints, preferably with negatives, and program listings should be machine generated hard copy output in black ink on white paper. Assembly language program listings need not be of especially high quality, since these are normally re-generated in the MICRO Systems Lab, but they must include object code as a check against typographical errors.

Since other MICRO readers will be copying your program code, please try to test your program thoroughly and ensure that it is as free from errors as possible. MICRO will pay for program listings, figures and illustrations, in addition to the text of an article; however, MICRO does not normally pay for figures that must be re-drawn or for programs that must be re-keyboarded in order to obtain a high contrast listing. Any program should include a reasonable amount of commentary, of course, and the comments should be part of the source code rather than explanations added to the listing.

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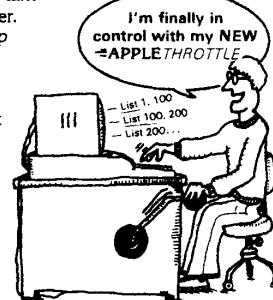
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Procedure to move Page 1 to page 2 from Basic on the Apple.

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How to hook-up two cassette recorders to the PET.

McCarthy, Charles A. "PET Basic Documentation", pg. 18-21.

Discussion of floating point numbers in PET Basic.

471. Dr. Dobbs Journal 3 Iss 6 No 26 (June/July, 1978)

Herzfeld, Andy "Lazarus", pg. 31-33.

A program to resurrect BASIC programs on the Apple II.

477. Softalk 1 Issue 1 (Apr., 1979)

Smith, Wm. V.R. and Depew, Wm. H. "Transferring Appletalk to Disk", pg. 1.

Detailed instructions from Softape on modifying their tapes for disk. SOFTALK is a newsletter published by Softape, 12 issues \$5.00.

Anon, "Talksaver, a Disk Save for Appletalk", pg. 2-3.
Procedure and software listing to allow Disk II owners to save the data tables created by Appletalk to a named disk file.

Anon, "Append Procedure for Prefix Programs", pg. 4.
Detailed procedure for appending prefix programs to tape or disk programs.

Anon, "How to Save Any Program in the Apple's Memory", pg. 6.

Many programs contain subroutines which interface with saving the program to tape. Here is a way to overcome this.

Anon, "Apple Memory Map", pg. 5.
Map showing just how Apple Talker and Apple-lis'ner are situated in memory.

473. Dr. Dobbs Journal 4 Issue 4 No 34 (Apr., 1979)

Prigot, Jonathon M. "OSI Basic for the KIM-1", pg. 37-39.
How to adapt the OSI Basic to KIM.

Lentzner, Mark "Improve Your OSI Resident Editor", pg. 46.
A simple program to fix a problem with OSI's resident.

475. Creative Computing 5 No 4 (Apr., 1979)

Milewski, Richard A. "Apple-Cart", pg. 22-23.

All about the EXEC command of the Apple DOS. With examples.

Yob, Gregory "Personal Electronic Transactions", pg. 28-32.
Discussion of the PET Clock with example, PET files, etc.

Zorn, Michael d. "Superose", pg. 98-99.
A rose program for the PET.

475. MICRO No 11 (Apr., 1979)

Hill, Alan G. "An Apple II Program Edit Aid", pg. 5-7.

A basic program to locate all occurrences of a variable name, character string or Basic statements.

Stelly, J. "Lifesaver", pg. 9-11.

This program makes it easy to save LIFE patterns to cassette, run Life at different rates, etc.

Vrtis, Nicholas J. "Corrected KIM Format Loader for SYM-1", pg. 12-14.

Program helps overcome the SYM-1's KIM tape "2F" problem with a corrected loader.

Hoyt, Bruce "A Close Look at the Superboard II", pg. 15-18.
In addition to an overview report on the Superboard II, there is presented a cassette save/hex memory dump program and a very useful table of memory usage.

Sensicle, Andrew V.W. "SKIM or MAXI-KIM", pg. 19-20.

An extended monitor supports a PC decrement function, as well as "open up" and "close up" modes to move blocks of data to make room for adding code and a branch calculator to help determine the relative branch addresses.

Stein, Robert A., Jr. "A Cassette Operating System for the Apple II", pg. 21-23.

Program makes it possible to load programs into the Apple by typing the name of the program and the cassette operating program goes looking for it and if it is found it is loaded into the Apple.

Tripp, Robert M., PhD "Ask the Doctor—Part III—Bits and Bytes", pg. 25-26.

Problems and fixes discussed this month include a corrected AIM SYNC program, a patch for the AIM-Dis-assembler, Sym Tape evaluation, and comments on Synertek Basic (8K) V1.1.

Rowe, Mike (Micro staff) "The Micro Software Catalog: VII", pg. 29-30.

Ten more entries.

Gieryc, John "SYM-1 6522-Based Timer", pg. 31-32.

A tutorial article on the timer and the working of the 6522 versatile interface adapter.

Chalfin, Edward "The TVT-6; A User's Report", pg. 34.

A user's impression of this inexpensive method of getting a video signal out of the KIM-1.

Dial, Wm. R. "6502 Bibliography—Part X", pg. 36.

Forty more references to the 6502 literature.

Rindsberg, Don "The Ultimate PET Renumber", pg. 37-47.

A major program for the PET.

476. The Paper 1 Iss 5 (July, 1978)

Oakes, Peter L.A. "Routines for Finding Arcsin and Arccos", pg. 4.

Improved routines for the PET.

Laudereau, Terry "PET Files", pg. 5.

Discussion of PET files and the commands, OPEN, CLOSE, INPUT#, GET#, etc.

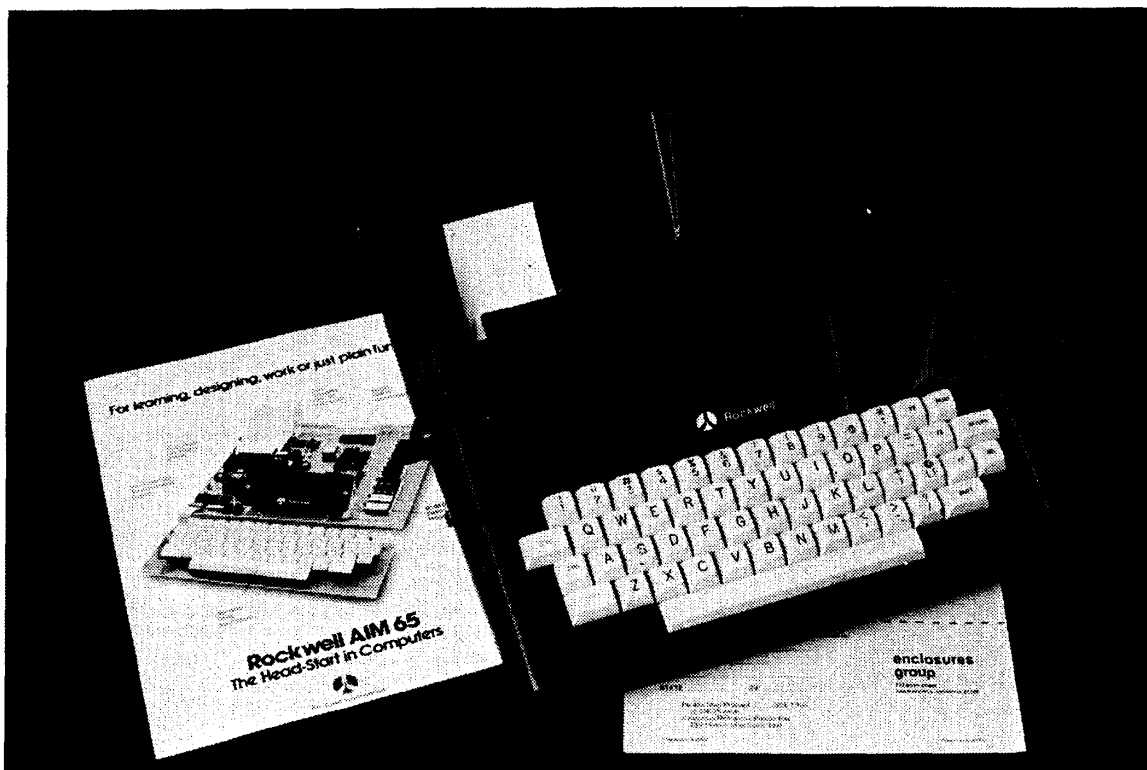
VanDusseldorp, Dean "Pause Routines", pg. 7.

PET program to provide pauses in a program.

Anon, "Simple Memory Test for PET", pg. 9.

Program runs until a bad Ram is found.

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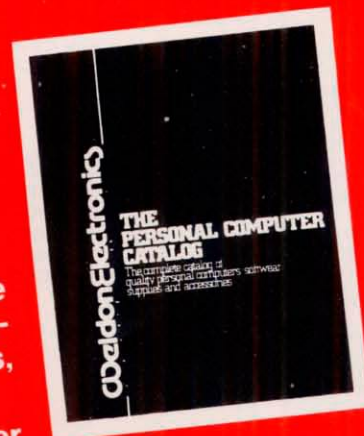
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PIE (PROGRAMMA IMPROVED EDITOR) is a two-dimensional cursor-based editor designed specifically for use with memory-mapped and cursor-based CRT's. It is totally different from the usual line-based editors, which were originally designed for Teletypes. The keys of the system input keyboard are assigned specific PIE Editor function commands. Some of the features included in the PIE system are: Blinking Cursor; Cursor movement up, down, right, left, plus tabs; Character insert and delete; String search forwards and backwards; Page scrolling; GOTO line number, plus top or bottom of file; Line insert and delete anywhere on screen; Move and copy (single and multiple lines); Append and clear to end of line; Efficient memory usage. The following commands are available in the PIE Text Editor and each is executed by depressing the systems argument key simultaneously with the command key desired:

[LEFT]	Move cursor one position to the left
[RGHT]	Move cursor one position to the right
[UP]	Move cursor up one line
[DOWN]	Move cursor down one line
[BHOM]	Home cursor in lower left hand corner
[HOME]	Home cursor in upper left hand corner
[-PAG]	Move up (toward top of file) one "page"
[+PAG]	Move down (toward bottom of file) one "page"
[LTAB]	Move cursor left one horizontal tab
[RTAB]	Move cursor right one horizontal tab
[GOTO]	Go to top of file (line 1)
[ARG] n[GOTO]	Go to line 'n'
[BOT]	Go to bottom of file (last line + 1)
[-SCH]	Search backwards (up) into file for the next occurrence of the string specified in the last search command
[ARG] t[-SCH]	Search backwards for string 't'
[+SCH]	Search forwards (down) into the file for the next occurrence of the string specified in the last search command
[ARG] t[+SCH]	Search forward for string 't'
[APP]	Append - move cursor to last character of line +1
[INS]	Insert a blank line before the current line
[ARG] n[INS]	Insert 'n' blank lines before the current line
[DEL]	Delete the current line, saving it in the "push" buffer
[ARG] n[DEL]	Delete 'n' lines and save the first 20 in the "push" buffer
[DBLK]	Delete the current line as long as it is blank
[PUSH]	Save current line in "push" buffer
[ARG] n[PUSH]	Save 'n' lines in the "push" buffer
[POP]	Copy the contents of the "push" buffer before the current line
[CINS]	Enable character insert mode
[CINS] [CINS]	Turn off character insert mode
[BS]	Backspace
[GOB]	Gobble - delete the current character and pull remainder of characters to right of cursor left one position
[EXIT]	Scroll all text off the screen and exit the editor
[ARG] [HOME]	Home Line - scroll up to move current line to top of screen
[APP] [APP]	Left justify cursor on current line
[ARG] [GOB]	Clear to end of line

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LISA is a totally new concept in assembly language programming. Whereas all other assemblers use a separate or co-resident text editor to enter the assembly language program and then an assembler to assemble the source code, LISA is fully interactive and performs syntax/addressing mode checks as the source code is entered in. This is similar in operation to the Apple II Integer BASIC Interpreter. All error messages that are displayed are in plain, easy to understand English, and not simply an Error Code. Commands in LISA are structured as close as possible to those in BASIC. Commands that are included are: LIST, DELETE, INSERT, PR #n, IN #n, SAVE, LOAD, APPEND, ASM, and a special user-definable key envisioned for use with "dumb" peripherals. LISA is DISK II based and will assemble programs with a textfile too long to fit into the Apple memory. Likewise, the code generated can also be stored on the Disk, hence freeing up memory for even larger source programs. Despite these Disk features, LISA is very fast; in fact LISA is faster than most other commercially available assemblers for the Apple II. Not only is LISA faster, but also, due to code compression techniques used LISA requires less memory space for the text file. A full source listing containing the object and source code are produced by LISA, in addition to the symbol table

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[label] [opcode] [operand]
[;comment]
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All valid addressing modes
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BYTE Directive to initialize memory locations
WORD Directive to initialize 16-bit words
PAGE Directive to control source listing
SKIP Directive to control source listing
OPT Directive to set select options
LINK Directive to chain multiple text files
Comments
Source listing with object code and source statements
Sorted symbol table listing

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